

Shoal Creek Watershed (II) Protection Plan

(Waterbody Segments IL_OI-05, IL_OI-13, & IL_OI-15) - Dissolved
Oxygen



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Acronyms and Abbreviations

AFO	animal feeding operation
BMP	best management practice
CWA	Clean Water Act
CAFO	concentrated animal feeding operation
CBMP	Council on Best Management Practices
DO	dissolved oxygen
HUC	Hydrologic Unit Code
IDOA	Illinois Department of Agriculture
IEPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
Ill. Adm. Code	Illinois Administrative Code
MS4	municipal separate storm sewer systems
NLRS	Nutrient Loss Reduction Strategy
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resources Conservation Service
STP	sewage treatment plant
TMDL	total maximum daily load
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WWTP	wastewater treatment plan

Units of Measurement

MGD	million gallons per day
mg/L	milligram per liter

Executive Summary

The Clean Water Act and U.S. Environmental Protection Agency (U.S. EPA) regulations require that Total Maximum Daily Loads (TMDLs) be developed for waters that do not support their designated uses. In simple terms, a TMDL is a plan to attain and maintain water quality standards in waters that are not currently meeting them.

The Shoal Creek watershed (II) addressed in this report includes 310 square miles of the larger Shoal Creek watershed (HUC 07140203) located in south central Illinois. Four segments in the Shoal Creek watershed were placed on the 2016 State of Illinois §303(d) list. Shoal Creek (IL_OI-05, IL_OI-13, and IL_OI-15) were listed due to low levels of dissolved oxygen (DO) and Shoal Creek (IL_OI-08) was listed due to elevated levels of iron. The iron impairment was removed from the 2018 draft 303(d) list. Potential causes of decreased DO levels in the watershed include point and nonpoint sources and can often be linked to eutrophication (high levels of algae) and nutrient loading.

The State of Illinois typically uses a three-stage approach to develop TMDLs for a watershed:

- Stage 1** – Watershed characterization, historical dataset evaluation, data analysis, methodology selection, data gap identification
- Stage 2** – Data collection to fill in data gaps, if necessary
- Stage 3** – Model calibration, TMDL scenarios, and implementation plan

The data summaries provided in this report indicate that Shoal Creek is no longer impaired for DO and therefore TMDLs were not developed for this watershed. A protection plan was developed instead to guide implementation of recommended practices to maintain acceptable levels of DO in Shoal Creek in the future. This final report represents a compilation of Stage 1 and Stage 2 and a protection plan. Stage 3 was not required as the data summaries in the previous stages indicate that is no longer impaired for DO

1. Introduction

The Clean Water Act (CWA) and U.S. Environmental Protection Agency (U.S. EPA) regulations require that Total Maximum Daily Loads (TMDLs) be developed for waters that do not support their designated uses. In simple terms, a TMDL is a plan to attain and maintain water quality standards in waters that are not currently meeting them.

The Shoal Creek watershed (II) addressed in this report is located in south central Illinois and includes a 310-square mile portion of the larger Shoal Creek watershed (HUC 07140203). Several Shoal Creek segments were placed on the State of Illinois §303(d) list in 2016 (Table 1) (Figure 1). Within the project area, three Shoal Creek segments (IL_OI-05, IL_OI-13, and IL_OI-15) were listed as being impaired for aquatic life due to low levels of dissolved oxygen (DO). The data summaries provided in this report indicate that these Shoal creek segments are no longer impaired for DO. Shoal Creek segment IL_OI-08 was listed as impaired for public and food processing water supplies due to elevated levels of iron, but this iron impairment was removed from the 2018 draft 303(d) list and is not addressed further in this report.

Table 1. Shoal Creek watershed impairments and pollutants (2016 Illinois 303(d) Draft List)

Name	Segment ID	Segment Length (Miles)	Watershed Area (Sq. Miles)	Designated Uses	Cause of Impairment
Shoal Creek	IL_OI-05	13.37	917	Aquatic Life	Dissolved Oxygen ^b
Shoal Creek	IL_OI-08	14.29	745	Public and Food Processing Water Supply	Iron ^a
Shoal Creek	IL_OI-13	11.49	726	Aquatic Life	Dissolved Oxygen ^b
Shoal Creek	IL_OI-15	11.12	685	Aquatic Life	Dissolved Oxygen ^b

a. Impairment was removed from the 2018 303(d) list and is not addressed further in this report.

b. No TMDLs developed; recommended protection activities provided in Section 5.

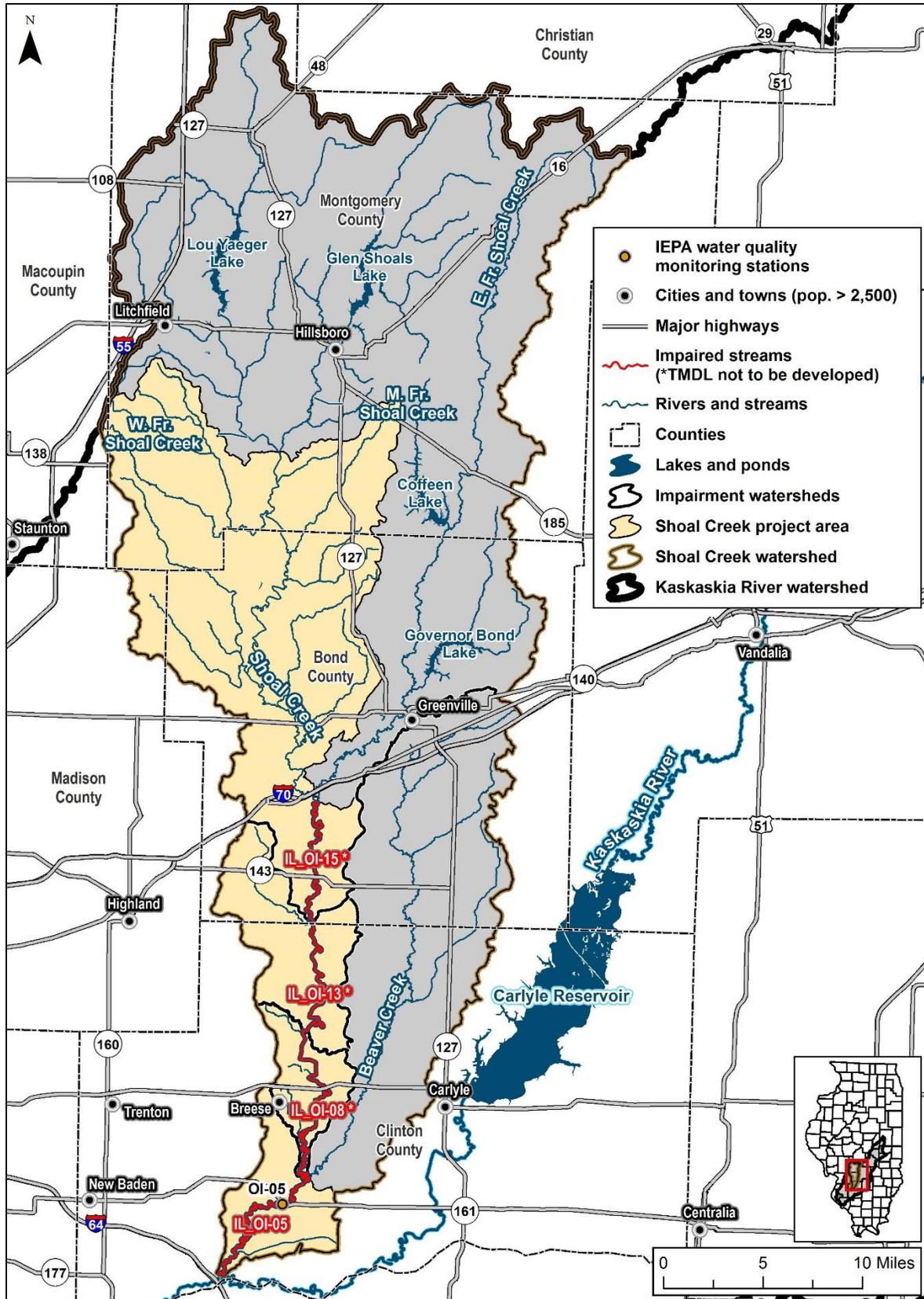


Figure 1. Shoal Creek Watershed (II) project area.

1.1 TMDL Development Process

The TMDL process typically establishes the allowable loading of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and instream conditions. This allowable loading represents the maximum quantity of the pollutant that the waterbody can receive without exceeding water quality standards. The TMDL also takes into account a margin of safety, which reflects scientific uncertainty, as well as the effects of seasonal variation. By following the TMDL process, States can establish water quality-based controls to reduce pollution from both point and nonpoint sources and restore and maintain the quality of their water resources (U.S. EPA 1991).

IEPA typically uses a three-stage approach to develop TMDLs for a watershed:

- Stage 1** – Watershed characterization, data analysis, methodology selection, data gap identification
- Stage 2** – Data collection to fill in data gaps, if necessary
- Stage 3** – Model development, TMDL scenario, and implementation plan

The purpose of Stage 1 is to characterize the watershed background; verify impairments in the listed waterbody by comparing observed data with water quality standards or appropriate targets; evaluate spatial and temporal water quality variation; provide a preliminary assessment of sources contributing to impairments; and describe potential TMDL development approaches. The Stage 1 report recommended additional data collection. The Stage 1 Report is provided in Appendix A. Data collected as part of Stage 2 are provided in Appendix B.

This protection plan includes relevant components of the original Stage 1 report and provides documentation needed to delist Shoal Creek segments for DO. A protection plan was developed which should guide implementation of recommended practices in order to maintain acceptable levels of DO in Shoal Creek in the future.

1.2 Water Quality Standards

This section presents information on the water quality standards, which are designed to protect beneficial uses. The authority to designate beneficial uses and adopt water quality standards is granted through Title 35 of the Illinois Administrative Code (Ill. Adm. Code). Designated uses to be protected in surface waters of the state are defined under Section 303, and water quality standards are designated under Section 302.

1.2.1 Designated Uses

IEPA uses rules and regulations adopted by the Illinois Pollution Control Board (IPCB) to assess the designated use support for Illinois waterbodies. The following are the use support designations provided by the IPCB that apply to waterbodies in the Shoal Creek watershed:

General Use Standards – These standards protect for aquatic life, wildlife, agricultural uses, primary contact (where physical configuration of the waterbody permits it, any recreational or other water use in which there is prolonged and intimate contact with the water involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard, such as swimming and water skiing), secondary contact (any recreational or other water use in which contact with the water is either incidental or accidental and in which the probability of ingesting appreciable quantities of water is minimal, such as fishing, commercial and recreational boating, and any limited contact incident to shoreline activity), and

most industrial uses. These standards are also designed to ensure the aesthetic quality of the state’s aquatic environment.

Shoal Creek segment IL_OI-05 is designated for DO enhanced protection according to 35 Ill. Adm. Code 302.206. Waters with enhanced protection have a more stringent DO standard than other waters of the State. These waters were chosen based on the potential biota (fish early life stages present) and the DO needed for these biota to thrive.

1.2.2 Endpoints

Water quality standards are published in 35 Ill. Adm. Code 302. This section presents the DO standards applicable to impairments within the Shoal Creek study area. Water quality standards are typically the endpoints to be used for TMDL development; in the Shoal Creek watershed, water quality standards (Table 2) are the endpoints to recommend delisting and to support development of the watershed protection plan.

Table 2. Summary of water quality standards for the Shoal Creek watershed

Parameter	Units	General Use Water Quality Standard for Waters with Enhanced Protection
Dissolved Oxygen ^a	mg/L	March-July > 5.0 min & > 6.25 7-day mean Aug-Feb > 4.0 min, > 4.5 7-day mean, & > 6.0 30-day mean

a. Applies to the dissolved oxygen concentration in the main body of all streams, in the water above the thermocline of thermally stratified lakes and reservoirs, and in the entire water column of unstratified lakes and reservoirs.

Aquatic life use assessments in streams are typically based on the interpretation of biological information, physicochemical water data and physical-habitat information from the Intensive Basin Survey, Ambient Water Quality Monitoring Network or Facility-Related Stream Survey programs. The primary biological measures used are the fish Index of Biotic Integrity (Karr et al. 1986; Smogor 2000, 2005), the macroinvertebrate Index of Biotic Integrity (Tetra Tech 2004) and the Macroinvertebrate Biotic Index (IEPA 1994). Physical habitat information used in assessments includes quantitative or qualitative measures of stream bottom composition and qualitative descriptors of channel and riparian conditions. Physicochemical water data used include measures of conventional parameters (e.g., DO, pH and temperature), priority pollutants, non-priority pollutants, and other pollutants (U.S. EPA 2002a and <https://www.epa.gov/wqc>). In a minority of streams for which biological information is unavailable, aquatic life use assessments are based primarily on physicochemical water data.

When a stream segment is determined to be Not Supporting aquatic life use, generally, one exceedance of an applicable Illinois water quality standards (related to the protection of aquatic life) results in identifying the parameter as a potential cause of impairment. Additional guidelines used to determine potential causes of impairment include site-specific standards (35 Ill. Adm. Code 303, Subpart C), or adjusted standards (published in the IPCB’s Environmental Register at <https://pcb.illinois.gov/Resources/EnvironmentalRegister>).

2. Watershed Characterization

The Shoal Creek watershed is located in southwestern Illinois and has a drainage area of 310 square miles. The watershed includes portions of Bond, Montgomery, Clinton, Madison, and Macoupin counties. The headwaters begin in northern Montgomery County and Christian County, IL and flow south towards its confluence with the Kaskaskia River. Shoal Creek joins the Upper Kaskaskia River downstream of Carlyle Lake and the Kaskaskia River eventually joins the Mississippi River south of St. Louis, Missouri. (Figure 1).

A TMDL was previously developed for a portion of the Shoal Creek watershed (IEPA 2008). The previous *Shoal Creek Watershed TMDL Report* provides the basis for the watershed characterization and source assessment for the current Shoal Creek watershed project area.

2.1 Jurisdictions and Population

Relevant information on jurisdictions and population can be found within the *Shoal Creek Watershed TMDL Report* (IEPA 2008). The project area is located within Bond, Montgomery, Clinton, Madison, and Macoupin counties.

2.2 Climate

In general, the climate of southern Illinois is temperate with hot summers and cold, snowy winters. Relevant information on climate can be found within the *Shoal Creek Watershed TMDL Report* (IEPA 2008).

2.3 Land Use and Land Cover

Relevant information on land use and land cover can be found within the *Shoal Creek Watershed TMDL Report* (IEPA 2008). Cultivated crops make up the majority of the land cover in the project area.

2.4 Topography

Relevant information on topography can be found within the recently completed *Shoal Creek Watershed TMDL Report* (IEPA 2008).

2.5 Soils

Relevant information on soils can be found within the *Shoal Creek Watershed TMDL Report* (IEPA 2008). Soils are primarily Group C that are defined as “soils having a slow infiltration rate when thoroughly wet” with slow infiltration rates. They typically consist of “soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture” (IEPA 2008).

2.6 Hydrology

Relevant information on hydrologic conditions can be found within the *Shoal Creek Watershed TMDL Report* (IEPA 2008). An active U.S. Geological Survey (USGS) flow gage site is located on the Shoal Creek IL_OI-08 segment (USGS gage 05594000).

2.7 Watershed Studies and Information

Relevant information for this section can be found within the *Shoal Creek Watershed TMDL Report* (IEPA 2008). County soil and water conservation districts and health departments were contacted for additional information; no new information was provided.

3. Watershed Source Assessment

Source assessments are an important component of water quality management plans and TMDL development. This section provides a summary of potential sources that contribute to low DO conditions in Shoal Creek.

3.1 Pollutants of Concern

Pollutants of concern evaluated within this source assessment include parameters influencing DO such as biochemical oxygen demand, phosphorus, and ammonia. These pollutants can originate from an array of sources including point and nonpoint sources. Eutrophication (high levels of algae) is also often linked directly to low DO conditions and therefore nutrients are also a pollutant of concern. Point sources typically discharge at a specific location from pipes, outfalls, and conveyance channels. Nonpoint sources are diffuse sources that have multiple routes of entry into surface waters, particularly overland runoff. This section provides a summary of potential point and nonpoint sources that contribute to Shoal Creek.

3.2 Point Sources

Point source pollution is defined by the Federal CWA §502(14) as:

“any discernible, confined and discrete conveyance, including any ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation [CAFO], or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agriculture storm water discharges and return flow from irrigated agriculture.”

Under the CWA, all point sources are regulated under the National Pollutant Discharge Elimination System (NPDES) program. A municipality, industry, or operation must apply for an NPDES permit if an activity at that facility discharges wastewater to surface water. Point sources can include facilities such as municipal wastewater treatment plants (WWTPs), industrial facilities, concentrated animal feeding operations (CAFOs), or regulated storm water including municipal separate storm sewer systems (MS4s).

Five NPDES permitted facilities are located in the watersheds draining to impaired segments IL_OI-05 and IL_OI-15; none are located in the IL_OI-13 watershed. Two permitted facilities are located in the Shoal Creek IL_OI-05 watershed - the Germantown Sewage Treatment Plant (STP; ILG580186) and one CAFO (ILA010007). Germantown STP is a domestic lagoon that discharges to an unnamed Shoal Creek tributary. Three individual NPDES permitted facilities are located in the Shoal Creek IL_OI-15 watershed - Pocahontas STP (ILG580010), Pierron East STP (ILG580237), and Louisville STP (ILG580081). Pocahontas STP and Pierron East STP discharge to tributaries of Shoal Creek and Louisville STP (ILG580081) discharges to the main stem of Shoal Creek. Design average flows and design maximum flows for these STPs are presented in Table 3.

No MS4s are located in the watersheds draining to the three impaired segments (IL_OI-05, IL_OI-13, and IL_OI-15).

Table 3. NPDES permitted facilities in the Shoal Creek watershed.

IL Permit ID	Facility Name	Type of Discharge	Receiving Water	Average Design Flow (MGD)	Maximum Design Flow (MGD)
ILG580186	Germantown STP	STP	Unnamed tributary of Shoal Creek	0.135	0.330
ILG580010	Pocahontas STP	STP	Unnamed tributary of Shoal Creek	0.125	0.5
ILG580237	Pierron East STP	STP	Unnamed tributary of Shoal Creek	0.0206	0.0854
ILG580081	Louisville STP	STP	Shoal Creek	0.15	0.375

MGD – Million gallons per day
STP – Sewage treatment plant

3.3 Nonpoint Sources

The term nonpoint source pollution is defined as any source of pollution that does not meet the legal definition of point sources. Nonpoint source pollution typically results from overland stormwater runoff that is diffuse in origin, as well as background conditions. It should be noted that stormwater collected and conveyed through a regulated MS4 is considered a controllable point source.

Nonpoint pollutant sources commonly associated with low DO conditions include agricultural runoff, onsite wastewater treatment systems, and animal agriculture activities. As part of the water resource assessment process, IEPA has identified several sources as contributing to the impairments: loss of riparian habitat, crop production (cropland or dry land), and agriculture, all of which are nonpoint sources.

3.3.1 Agricultural Runoff

During wet-weather events (snowmelt and rainfall), pollutants are incorporated into runoff and can be delivered to downstream waterbodies. The resultant pollutant loads are linked to the land uses and practices in the watershed. Agricultural areas can have significant effects on water quality if proper best management practices are not in place, specifically contributing to high biochemical oxygen demand and nutrients that can affect the DO conditions in streams. Drain tiles also transport agricultural runoff directly to ditches and streams, whereas runoff flowing over the land surface may infiltrate to the subsurface and may flow through riparian areas. The majority of land within the Shoal Creek watershed is in cultivated crops.

3.3.2 Onsite Wastewater Treatment Systems

Onsite wastewater treatment systems (e.g., septic systems) that are properly designed and maintained should not serve as a source of contamination to surface waters. However, onsite systems do fail for a variety of reasons. Common soil-type limitations which contribute to failure include seasonally high water tables, compact glacial till, bedrock, and fragipan. When these septic systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration) there can be adverse effects to surface waters (Horsley and Witten 1996). Septic systems contain all the wastewater discharged from homes and business and can be significant sources of pollutants.

IEPA estimates that between 20–60 percent of onsite wastewater treatment systems are failing in the state of Illinois (IEPA 2004). During the development of this TMDL county health departments were contacted for county specific information on septic systems and unsewered communities. Septic systems throughout the watershed are typically inspected during installation and on a complaint-basis. There are approximately 20,000 septic systems in Madison County. In 2017, 223 systems were inspected in

Madison County and 96.5 percent of systems that were previous found under violation were brought into compliance.

3.3.3 Animal Feeding Operations (AFOs)

Animal feeding operations that are not classified as CAFOs are known as animal feeding operations (AFOs) in Illinois. Non-CAFO AFOs are considered nonpoint sources by U.S. EPA. AFOs in Illinois do not have state permits. However, they are subject to state livestock waste regulations and may be inspected by the IEPA, either in response to complaints or as part of the Agency's field inspection responsibilities to determine compliance by facilities subject to water pollution and livestock waste regulations. The animals raised in AFOs produce manure that is stored in pits, lagoons, tanks and other storage structures. The manure is then applied to area fields as fertilizer. When stored and applied properly, this beneficial re-use of manure provides a natural source for crop nutrition. It also lessens the need for fuel and other natural resources that are used in the production of fertilizer. AFOs, however, can pose environmental concerns, including the following:

- Manure can leak or spill from storage pits, lagoons, tanks, etc.
- Improper application of manure can contaminate surface or ground water.
- Manure over application can adversely impact soil productivity.

Livestock are potential sources of nutrients to streams, particularly when direct access is not restricted and/or where feeding structures are located adjacent to riparian areas. Bond and Clinton Soil and Water Conservation Districts received a 319 grant from IEPA in 2016 to continue work in the two counties assisting livestock producers in making improvements to their animal waste systems to reduce nutrient and sediment loading to waterbodies.

4. Water Quality

Background information on water quality monitoring can be found in the recently completed *Shoal Creek Total Maximum Daily Load* (IEPA 2008). In the Shoal Creek watershed, water quality data were found for numerous stations that are part of the Illinois EPA Ambient Water Quality Monitoring Network. Parameters sampled in the streams include field measurements (e.g., DO) as well as those that require lab analyses (e.g., nutrients). For the Stage 1 analysis, the most recent 10 years of data collection, 2007–2016, were used to evaluate impairment status. Data that are greater than 10 years old are not included in impairment status evaluation; however, data from 2002 were available for segment IL_OI-05. Each data point was reviewed to ensure the use of quality data in the analysis below. Data were obtained directly from Illinois EPA.

The following sections (1) summarize initial data used for impairment verification in Stage 1, (2) identify the Stage 2 monitoring recommendations following the initial Stage 1 analysis, and (3) analyze any data collected in response to those recommendations. Data were collected by IEPA and the Illinois State Water Survey in 2019 in Shoal Creek IL_OI-05 and IL_OI-13. See Appendix B for all Stage 2 data.

4.1 Shoal Creek (IL_OI-05)

Shoal Creek (IL_OI-05) is listed as impaired for aquatic life due to low levels of DO. One IEPA sampling site is present on segment IL_OI-05 of Shoal Creek (Table 4 and Figure 2). Ten samples were collected at the site from 2007–2012. Four violations of the general use water quality standard – enhanced protection were observed in June and August 2007 and July of 2012. Continuous DO data were collected in 2007 and 2017; multiple violations of the standard were observed in July and August 2007 (Figure 3). During the Stage 1 process, these violations verify impairment.

Further review of available data was conducted to determine the cause of impairment:

- **Point Sources:** The point source discharging into Shoal Creek is downstream from the monitoring station (OI-05) and is therefore not contributing to the impairment.
- **Eutrophication:** Available phosphorus data were evaluated to determine if eutrophication was contributing to low DO conditions; however, no eutrophication relationship exists between high levels of phosphorus and low levels of DO (Figure 4).

Although the impairment had been verified, a strong link to a pollutant was not present during Stage 1 analysis and there are no point sources contributing to the impairment that has been assessed based on data at OI-05. The following additional data needs were identified:

Collect DO, chlorophyll-*a*, and TP grab samples at station OI-05; two samples per day (one per day in the early morning) on three separate sampling days, during the warm summer months (July–August) and during low flows.

In response to this recommendation, additional DO data were collected in September and October 2019. Continuously recording data sondes were used to collect DO measurements in the morning and afternoon on each day of sampling. The data were averaged for each morning and each afternoon (Table 5).

All measurements were greater than the 4.0 mg/L enhanced instantaneous minimum standard for August through February (refer to the Section 1.2 for a discussion of standards).

IEPA provided new guidelines in 2020 to assess streams using continuous DO data and recommended that a shorter window of time be considered. Specifically, for assessment in 2020, IEPA considers data collected between 2015 and 2017. As 2019 DO data do not exceed standards, the segment is recommended for delisting, and no further TMDL work has been conducted.

Table 4. Data summary, Shoal Creek OI-05

Sample Site	No. of samples	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Number of exceedances of general use water quality standard – enhanced protection (>5 mg/L (Mar-Jul) and >4 mg/L (Aug-Feb))
OI-05	10	3.1	5.4	8.8	4

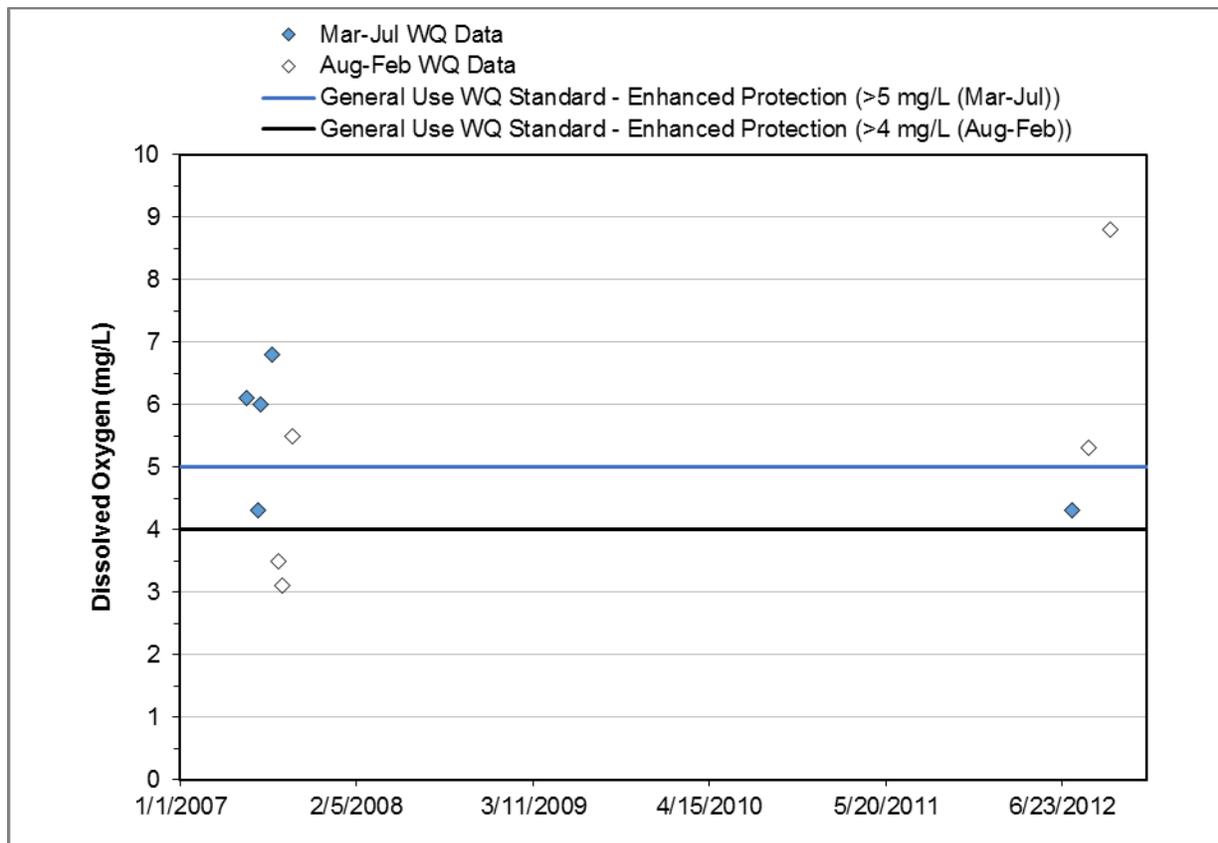


Figure 2. Dissolved oxygen water quality time series, Shoal Creek OI-05.

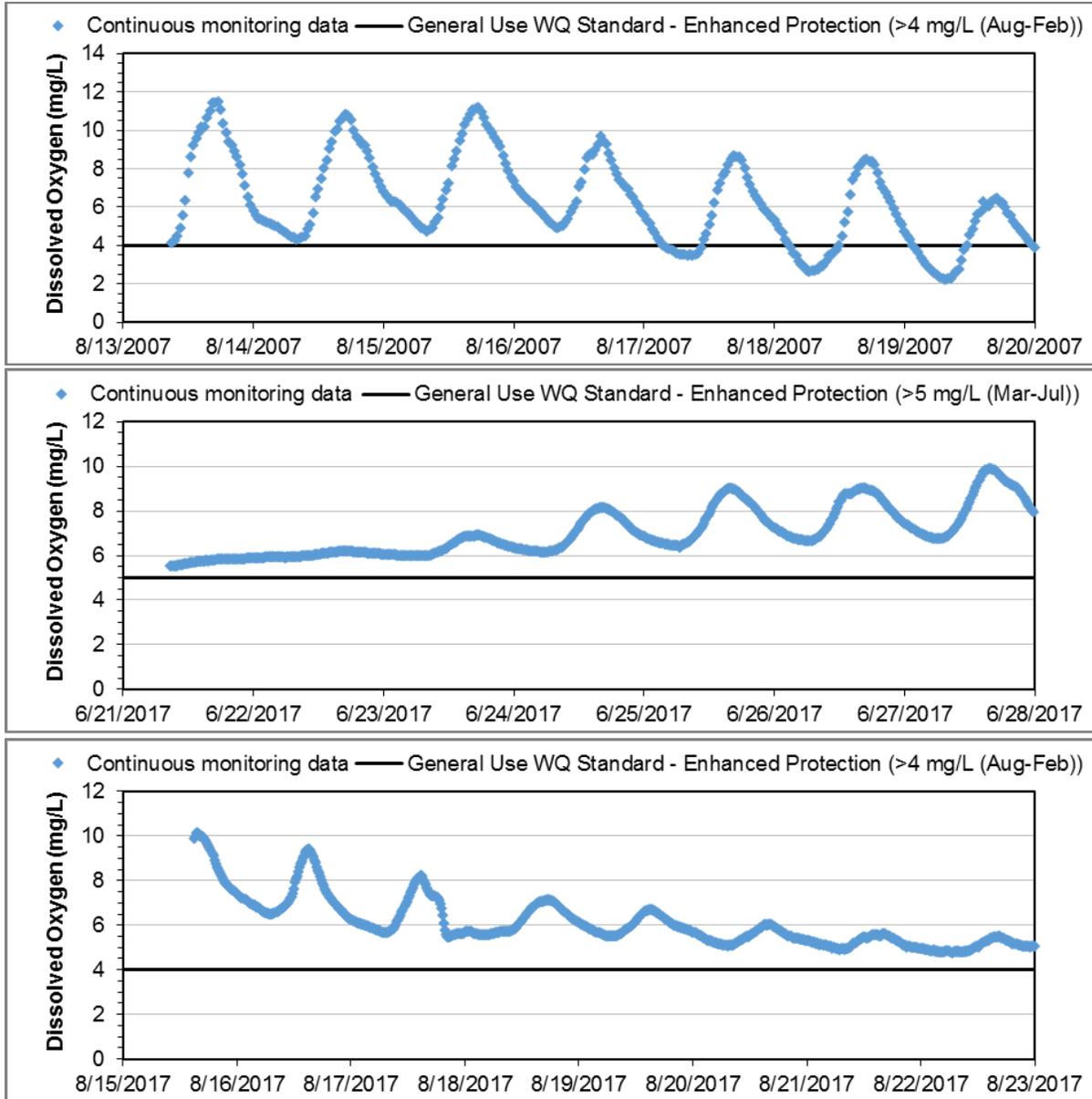


Figure 3. Continuous water quality time series for dissolved oxygen, Shoal Creek OI-05 segment.

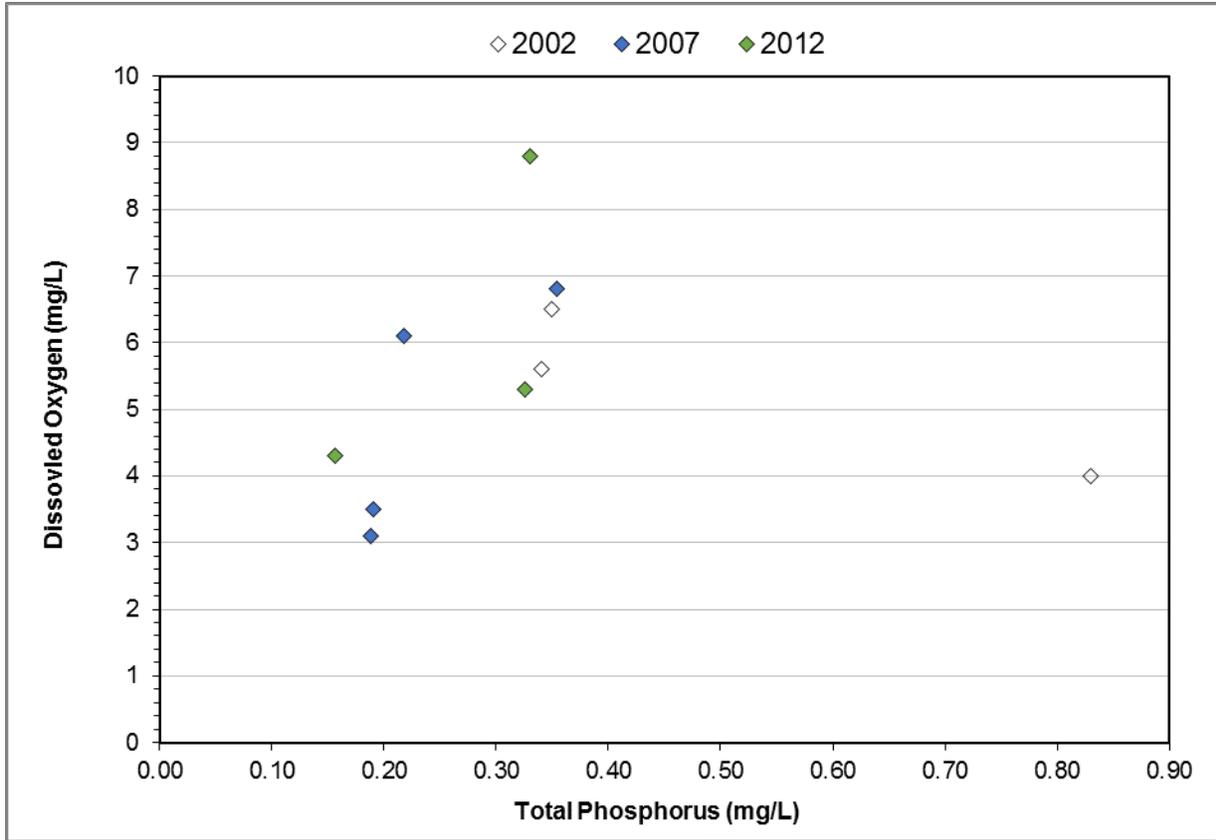


Figure 4. Total phosphorus verse dissolved oxygen, Shoal Creek OI-05.

Table 5. Dissolved oxygen data (Shoal Creek at monitoring site OI-05)

Date	Time of Day	Dissolved oxygen (mg/L)
9/23/2019	AM	6.54
	PM	7.39
9/30/2019	AM	6.77
	PM	7.37
10/7/2019	AM	7.38
	PM	7.62

4.2 Shoal Creek (IL_OI-13)

Shoal Creek segment IL_OI-13 is listed as impaired for aquatic life due to DO. One IEPA sampling site (OI-13) was identified on the segment. As part of the Stage 1 analysis, data collection between 2007–2016 did not indicate impairment in the segment (Figure 5); however, due to the small sample size, the following additional data were recommended to verify impairment:

- Additional continuous DO data should be collected at OI-13 for 7 days during low flow conditions.
- Alternatively, collect DO, chlorophyll-*a*, and TP grab samples at station OI-13; two samples per day (one per day in the early morning) on three separate sampling days, during the warm summer months (July–August) and during low flows. This grab sampling will also satisfy the monitoring needs to determine the relationship with eutrophication and evaluate 4C classification.

In response to these recommendations, additional DO data were collected during September and October 2019 to confirm the status of this reach. Continuously recording data sondes were used to collect DO measurements in the morning and afternoon on each day of sampling in 2019. The data were averaged for each morning and each afternoon (Table 6).

All the measurements were greater than the 3.5 mg/L instantaneous minimum standard for August through February (refer to Section 1.2 for a discussion of standards). There are no data that indicate DO impairment. Based upon IEPA's new guidelines to focus on 2015 through 2019 DO data, since 2019 data do not indicate impairment, this segment is recommended for delisting.

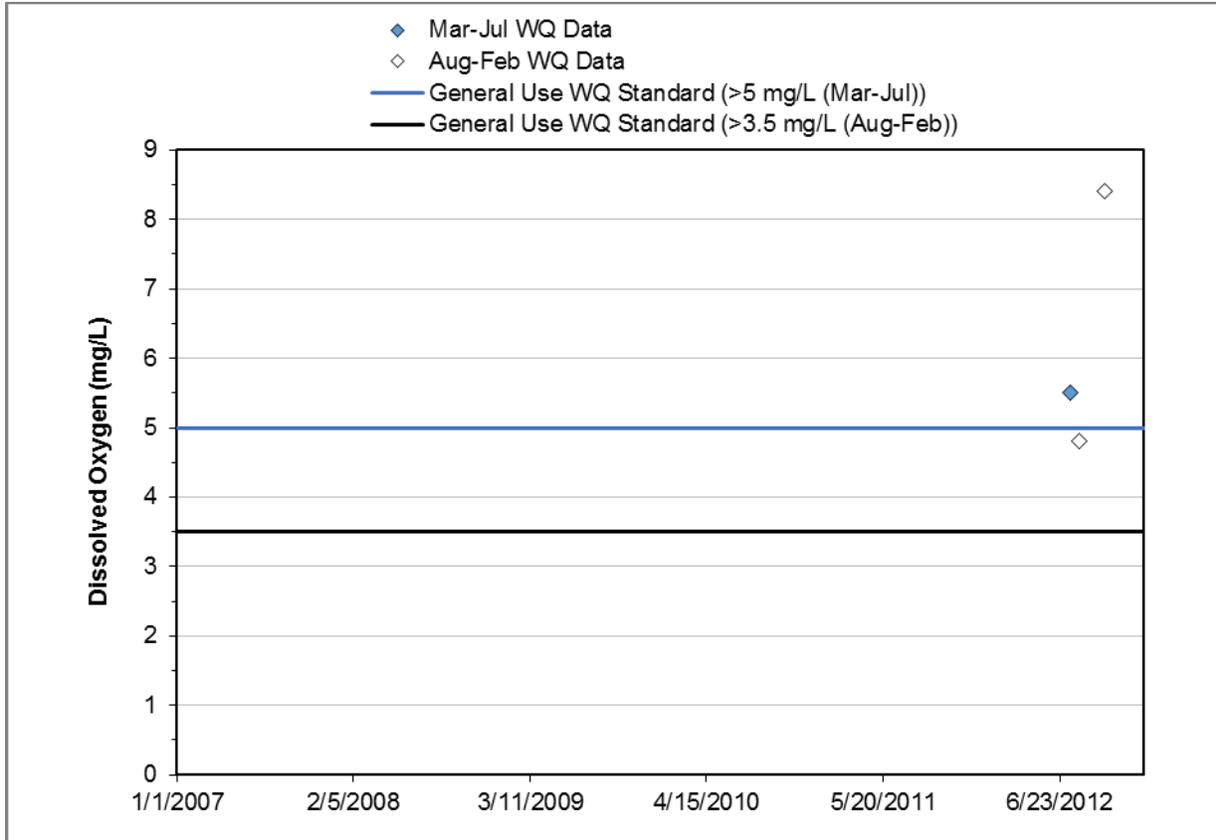


Figure 5. Dissolved oxygen water quality time series, Shoal Creek OI-13.

Table 6. Dissolved oxygen data (Shoal Creek at monitoring site OI-13)

Date	Time of Day	Dissolved oxygen (mg/L)
9/23/2019	AM	8.17
	PM	10.08
9/30/2019	AM	6.81
	PM	7.34
10/7/2019	AM	7.80
	PM	8.27

4.3 Shoal Creek (IL_OI-15)

Shoal Creek segment (IL_OI-15) is listed as impaired for aquatic life due to DO. One IEPA sampling site was identified on the segment, OI-15. Data collection between 2007–2012 (Figure 6) and continuous data from June and August 2017 (Figure 7) do not indicate impairment. No additional DO data were collected during 2019 to confirm the status of this reach.

Three grab samples each collected in 2007 and 2012 ranged from 5.2 to 9.5 mg/L. Thus no sample collected in August through February was less than 3.5 mg/L and no sample collected in March through September was less than 5.0 mg/L.

Continuous data were collected in June and August 2017. The June 2017 continuous DO data ranged from 5.5 to 11.2 mg/L and were always greater than 5.0 mg/L. The August 2017 continuous DO data ranged from 4.3 to 8.0 mg/L and were always greater than 3.5 mg/L.

IEPA provided new guidelines in 2020 to assess streams using continuous DO data and recommended that a shorter window of time be considered. Specifically, for assessment in 2020, IEPA considers data collected between 2015 and 2017. Since the 2017 DO data do not exceed standards, the segment is recommended for delisting DO.

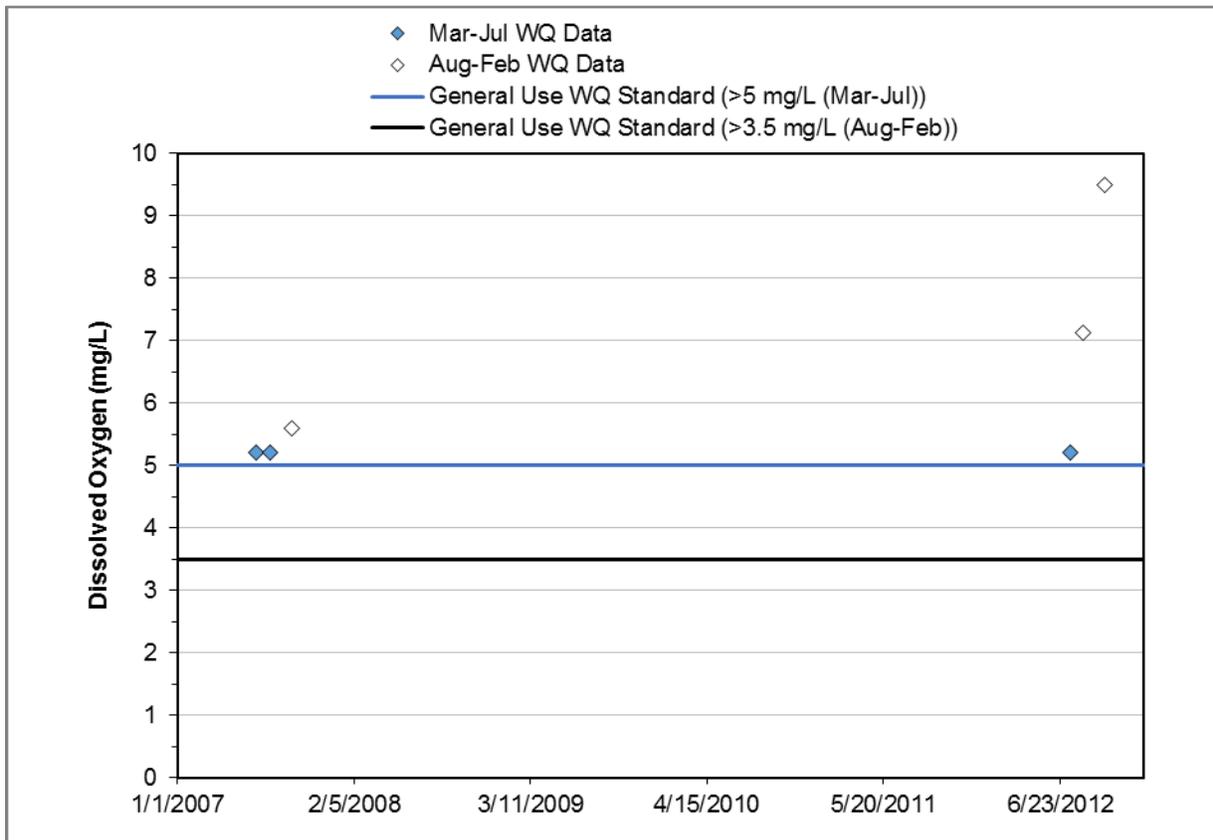


Figure 6. Dissolved oxygen water quality time series, Shoal Creek OI-15.

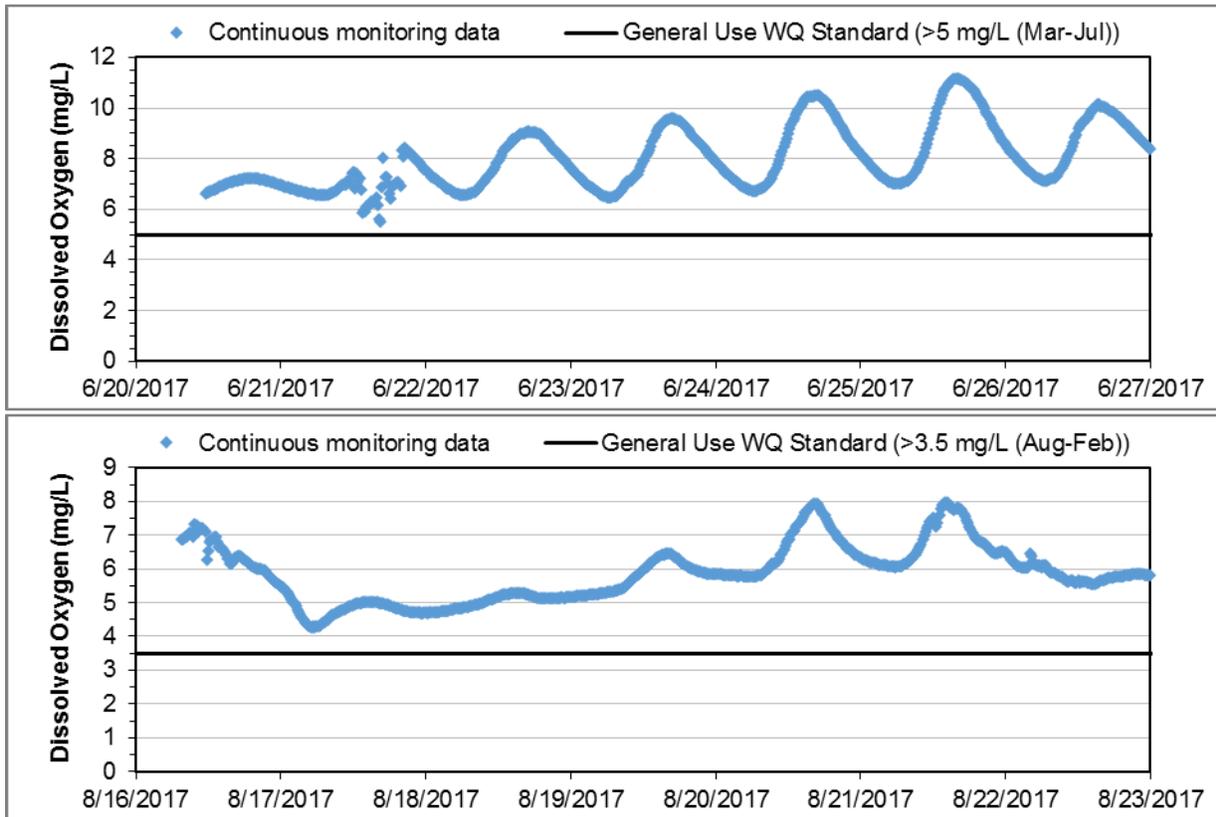


Figure 7. Continuous water quality time series for dissolved oxygen, Shoal Creek OI-15 segment.

5. Protection Plan

The data summaries provided in Section 4 indicate that Shoal Creek segments (IL_OI-05, IL_OI-13, and IL_OI-15) are no longer impaired for low DO. As such, a protection plan has been developed in lieu of a TMDL implementation plan to maintain and improve in-stream DO levels and prevent increases in pollutants that may impact DO levels (such as phosphorus). In addition to a suite of protection activities, this plan provides monitoring recommendations and an adaptive management process to ensure that implemented practices remain effective. The activities recommended in this protection plan not only help to protect waters from impairment but can also result in a cleaner, healthier watershed for the people who depend on the resources for their livelihood now and in the future.

5.1 Recommended Protection Activities

To maintain acceptable levels of DO in the Shoal Creek watershed, a number of best management practices (BMPs) can be implemented. Maintaining and protecting current conditions can be accomplished by prioritizing BMPs that reduce nutrient loss from the watershed and maintain and improve in-stream conditions that are supportive of healthy DO levels. Education and outreach activities complement BMPs by creating stewardship opportunities and ensuring stakeholder engagement in future watershed activities.

5.1.1 Protection Activities

During wet-weather events (snowmelt and rainfall), nutrients are incorporated into runoff and can be delivered to downstream waterbodies. Several cropland BMPs are recommended to reduce nutrient loss from cropland. The following practices are a subset of those provided in the Illinois Nutrient Loss Reduction Strategy (NLRs) and by the Illinois Council on Best Management Practices (CBMP). Additional information is available in the NLRs (IDOA and IEPA 2015) and on the Illinois CBMP website (<http://illinoiscbmp.com/>). Many of these practices have the added benefit of improving soil health.

Conservation Tillage

The Illinois NLRs identifies reduced or conservation tillage as a primary BMP to control phosphorus loading to waters. The Illinois Agronomy Handbook defines conservation tillage as any tillage practice that results in at least 30% coverage of the soil surface by crop residuals after planting (University of Illinois Extension 2009). Several practices are commonly used to maintain the suggested 30% cover:

- **No-till** systems disturb only a small row of soil during planting, and typically use a drill or knife to plant seeds below the soil surface.
- **Strip till** operations leave the areas between rows undisturbed but remove residual cover above the seed to allow for proper moisture and temperature conditions for seed germination.
- **Ridge till** systems leave the soil undisturbed between harvest and planting: cultivation during the growing season is used to form ridges around growing plants. During or prior to the next planting, the top 0.5 to 2 inches of soil, residuals, and weed seeds are removed, leaving a relatively moist seed bed.
- **Mulch till** systems are any practice that results in at least 30% residual surface cover, excluding no-till and ridge till systems.

Corn residues are more durable and capable of sustaining the required 30% cover required for conservation tillage. Soybeans generate less residue, the residue degrades more quickly, and supplemental measures or special care may be necessary to meet the 30% cover requirement. Based on 2018 satellite imagery, 35% of the cropland acres in the Shoal Creek major watershed had residue greater than 30% (Applied Geosolutions LLC et al. 2019).

Cover Crops

Winter cover crops are also identified in the NRLS as an important management practice (IDOA and IEPA 2015). According to the Natural Resources Conservation Service (NRCS), cover crops “have the potential to provide multiple benefits in a cropping system. They can prevent soil and wind erosion, improve soil’s physical and biological properties, supply nutrients, suppress weeds, improve the availability of soil water, and break pest cycles along with various other benefits. The species of cover crop selected along with its management determine the benefits and returns” (NRCS 2020). There are many different types of crops being used for cover crops, including various grasses and legumes. Based on 2018 satellite imagery, 4% of the cropland acres in the Shoal Creek major watershed had winter cover crops (Applied Geosolutions LLC et al. 2019).

Fertilizer Management

Proper application of fertilizer (both commercial and manure) to cropland can greatly reduce nutrient levels in agricultural runoff. In general, fertilizer management aims to optimize application rates and improve storage and disposal of fertilizer to reduce pollution in runoff.

The Illinois Agronomy Handbook lists guidelines for fertilizer application rates based on the inherent properties of the soil (typical regional soil phosphorus concentrations, root penetration, pH, etc.), the starting soil test phosphorus concentration for the field, and the crop type and expected yield (University of Illinois Extension 2009). Limiting commercial application of fertilizers to only fields with soil test phosphorus levels below the recommended maintenance and applying nitrogen according to the University of Illinois “Maximum Return to Nitrogen” recommendations can reduce nutrient loading from excess fertilization. Application of fertilizer should address application rates, methods, and timing as described in the NRLS and according to the 4Rs – **Right Source**, **Right Rate**, at the **Right Time**, and in the **Right Place**. Application to frozen ground or snow cover should be strongly discouraged. Researchers studying loads from agricultural fields in east-central Illinois found that fertilizer application to frozen ground or snow followed by a rain event could transport 40% of the total annual phosphorus load (Gentry et al. 2007).

Fertilizer transport, storage, and disposal practices should also be monitored to reduce potential pollution in runoff. Commercial fertilizers should be stored at least 100 feet from nearby surface waters and should not be stored underground or in pits. Application equipment should be cleaned, inspected, and calibrated regularly, and excess fertilizer from wash water should be recovered for reuse. Disposal of commercialized fertilizers should follow manufacturer guidelines. Improvements to storage and disposal practices may require improvements to existing equipment or storage infrastructure to reduce potential leakages.

Livestock BMPs

Proper management of runoff and waste is important to improving water quality and reducing nutrient loading to the watershed. Animal operations are typically either pasture-based or confined, or sometimes a combination of the two. The operation type dictates the practices needed to manage manure and soil erosion from the facility. A pasture or open lot system with a relatively low density of animals (1 to 2 head of cattle per acre [U.S. EPA 2003]) may not produce manure in quantities that require management for the protection of water quality. If excess manure is produced, then the manure will typically be stored, which can then be land applied. Application of manure should be at agronomic rates, taking into account commercial fertilizer application, when the ground is not frozen and precipitation forecasts are low. Rainfall runoff should be diverted around storage facilities with berms or grassed waterways.

Confined facilities (typically dairy cattle, swine, and poultry operations) often collect manure in storage pits. Wash water used to clean the floors and remove manure buildup combines with the solid manure to

form a liquid or slurry in the pit. Final disposal of waste usually involves land application on the farm or transportation to another site.

Livestock operation BMPs generally seek to contain manure and manure wastewater; contain and treat runoff contaminated with manure or manure wastewater; divert clean water; and prevent runoff following manure land application. The following livestock and feedlot BMPs are recommended:

- **Composting manure structures and manure management.** Composting manure structures contain manure and other organic materials as they are broken down through aerobic microbial processes. Once decomposed, the organic materials are suitable for storage, on farm use, and application to land as a soil amendment. Composting facilities typically consist of a concrete floor separated by stalls, cover such as a roof or loose tarp is recommended to maintain an environment conducive to aerobic digestion (NRCS 2017a). Other manure management practices include:
 - Grading, earthen berms, and such to collect, direct, and contain manure
 - Installation of concrete pads
- **Runoff management** (runoff from production areas)
 - Grading, earthen berms, and such to collect and direct manure-laden runoff
 - Filter strips
 - Storage ponds
- **Clean water diversion**
 - Roof runoff management
 - Grading, earthen berms, and such to collect and direct uncontaminated runoff
- **Manure land application**
 - Nutrient management strategy (e.g., the 4Rs: **R**ight Source, **R**ight Rate, **R**ight Time, **R**ight Place), see Fertilizer Management
 - Filter strips and grassed waterways

In addition, BMPs for alternative water systems and exclusion fencing can be used to reduce nutrients from livestock with access to streams. These BMPs limit or eliminate livestock access to a stream or waterbody. Fencing can be used with controlled stream crossings to allow livestock to cross a stream while minimizing disturbance to the stream channel and streambanks. Providing alternative water supplies for livestock allows animals to access drinking water away from the stream, thereby minimizing the impacts to the stream and riparian corridor. U.S. EPA (2003) studied the impacts of providing alternative watering sites without structural exclusions and found that cattle spend 90% less time in the stream when alternative drinking water is furnished and estimates that total phosphorus reductions from 15-49% can be expected.

Additional information on the context of these practices within the Shoal Creek watershed is available in the 2008 *Shoal Creek Watershed TMDL Report* (IEPA 2008).

Riparian Buffers and Filter Strips

Riparian buffers provide many benefits and can effectively address water quality degradation. Riparian buffers that include perennial vegetation and trees can filter runoff from adjacent cropland, provide shade and habitat for wildlife, and reinforce streambanks to minimize erosion. The root structure of the vegetation in a buffer enhances infiltration of runoff and subsequent trapping of pollutants. However, buffers are only effective in this manner when the runoff enters the buffer as a slow moving, shallow “sheet”; concentrated flow in a ditch or gully, will quickly pass through the buffer offering minimal

opportunity for retention and uptake of pollutants. Similarly, tile lines can often allow water to bypass a buffer, thus reducing its effectiveness. The NRCS suggests a 35-foot wide buffer.

Filter strips are a strip of permanent vegetation located between disturbed land (cropland or pastureland) and environmentally sensitive areas that can effectively address water quality degradation from nutrient loading while also enhancing habitat (NRCS 2017b). Filter strips provide many of the same benefits as vegetated buffers but are also subject to the same design considerations. Determining adequate filter strip widths depends on the slope of the land. Table 7 summarizes the minimum and maximum flow lengths for filter strips according to Illinois NRCS standards.

Table 7. Minimum and maximum filter strip length for land slope (NRCS 2017b)

Slope (%)	0.5	1.0	2.0	3.0	4.0	5.0 or greater
Minimum (feet)	36	54	72	90	108	117
Maximum (feet)	72	108	144	180	216	234

Onsite Wastewater Treatment System Practices

Onsite wastewater treatment systems (e.g., septic systems) that are properly designed and maintained should not serve as a source of contamination to surface waters. However, if systems are maintained improperly, sited improperly, or are connected to subsurface or tile drainage systems, they can have adverse effects on surface waters.

IEPA estimates that between 20–60% of onsite wastewater treatment systems are failing in the state of Illinois (IEPA 2004). Septic systems throughout the watershed are typically inspected during installation and on a complaint basis. There are approximately 20,000 septic systems in Madison County. In 2017, 223 systems were inspected in Madison County and 96.5% of systems that were previous found under violation were brought into compliance.

BMPs to reduce nutrient loads from septic systems include maintenance, inspection programs, and public education. The most effective BMP for managing loads from septic systems is regular maintenance. U.S. EPA recommends that septic tanks be pumped every 3 to 5 years depending on the tank size and number of residents in the household (U.S. EPA 2002b). Annual inspections, in addition to regular maintenance, ensure that systems are functioning properly. Additional point of sale inspections, or inspections when a property is sold and purchased, can improve the baseline understanding of septic conditions and decrease occurrences of leaks potentially contributing to nutrient loading in the watershed.

Several areas within the watershed are served by sewers. Within rural areas of Illinois, such as the Shoal Creek watershed, it is assumed that non-sewered communities rely on septic systems.

5.1.2 Protection Activities to Maintain and Improve In-Stream Conditions

In-stream conditions that may be contributing to low DO conditions may include stagnant water, lack of riffles, channelization, lack of shade, and lack of adequate flow. Restoration of altered (channelized or ponded) stream segments can greatly enhance the stream function, habitat, and water quality. Altered stream segments can be addressed by many different BMPs:

- **Engineering controls** include armoring with materials that straighten the banks, deflection of the water course with rock or log structures, and removal of debris to restore flows. Example practices include stone toes, stream barbs and removal of any problematic log jams that contribute to erosion.
- **Vegetative stabilization and restoration of riparian areas** can reduce peak flows from runoff areas and channel velocities directing runoff. Using vegetative controls also enhance infiltration, which reduces high flows that cause erosion.

- **Natural channel restoration** that establishes meanders and natural flow complexity and connects the stream channel with the floodplain.
- **Riffles** provide breaks in stream segments where stream alterations have impacted aeration or have destabilized stream beds. Constructed riffles are engineered using alluvial materials or to increase hydraulic complexity, provide aquatic habitats, and stabilize beds in altered streams.
- **Pooling**, or stream portions with deeper and slower flows, occur organically along many natural stream segments. Constructed pool systems, such as step or riffle-pools, may be implemented to slow flow velocities, provide aquatic habitat, reduce sedimentation, and lower water temperatures in altered or straightened stream segments.

5.1.3 Education and Outreach Activities

Raising stakeholders' awareness about issues in the watershed and developing strategies to change stakeholders' behavior is essential to promoting voluntary participation. Successful implementation in the Shoal Creek watershed will rely heavily on effective public education and outreach activities that will encourage participation and produce changes in behavior. This section presents recommendations related to developing and implementing coordinated watershed-wide education and outreach.

The first step to a successful information and education strategy is to identify target audiences and determine how to best reach these audiences. Potential audiences in the Shoal Creek watershed may include homeowners, row crop and livestock producers, and public works departments and staff. Consideration should be given to the complexity of the water resource concerns of each of these groups. Whenever possible, stakeholder attitudes and preferences should be considered in the implementation of protection activities and should influence message development, selection of outreach platforms, and other aspects of information and education.

Engagement and outreach strategies should also be flexible to accommodate future changes in stakeholder awareness and behaviors. A pre- and post-implementation survey can be used to measure these changes, and the results of these surveys should be shared between local partners. These surveys can be used to measure changes in the level of stakeholder knowledge and involvement and will help watershed outreach campaign organizers to further develop tailored outreach messages. Other measures of change can include the number of producers who are signing up for cost-share programs or participating in field days or demonstration projects. Results from these outreach activities should be used to inform potential changes and adaptations to this protection plan.

5.2 Priority Areas for Implementation

Prioritization of implementation activities should occur based on stakeholder input, willing landowners, and availability of funding. In addition, prioritization can focus on areas with the greatest potential for pollutants to negatively impact water quality:

- **Cropland:** Agricultural land uses comprise 65% of land cover in the Shoal Creek watershed. Cropland typically contributes to pollutant loading during wet-weather events that result in erosion and runoff. The contribution of nutrient loading from cropland runoff is also exacerbated by the presence of tile drainage lines in the watershed, which is estimated in previous planning efforts (IEPA 2008).
- **Pasture and animal feeding operations:** Areas of the watershed with grazed pastures and other non-permitted AFOs are potential sources of nutrients to streams, particularly when livestock can access streams and where feeding structures are located adjacent to riparian areas.

- **Failing septic systems:** Private septic systems in the watershed may negatively impact water quality issues in the watershed if septic systems are not properly maintained and inspected.
- **Altered (channelized or ponded) stream segments:** Land use changes, ditching, and other hydrologic modifications may detrimentally affect habitat and biological health in riparian areas and result in lower DO levels. Altered segments should be targeted during implementation.

Management practices recommended for each of these priority areas are provided in Table 8.

Table 8. Recommended BMPs by priority area

Recommended best management practice (BMP)	Priority area for implementation			
	Cropland	Pasture and animal feeding operations	Failing septic systems	Altered (channelized or ponded) stream segments
Conservation tillage	x			
Cover crops	x			
Fertilizer management	x	x		
Livestock BMPs		x		x
Riparian buffers and filter strips	x	x		x
Onsite wastewater treatment system practices			x	
Practices to maintain and improve in-stream conditions				x
Education and outreach	x	x	x	x

5.3 Monitoring Recommendations

The ultimate measure of success will be maintained or improved water quality over time. Monitoring will help determine whether the recommended practices have maintained water quality levels or if further action is needed.

DO should continue to be evaluated through ambient monitoring by IEPA. The state conducts routine water quality monitoring by evaluating watersheds on a rotating basis, collecting measurements of physical, chemical, and biological parameters. In addition to the ambient monitoring program conducted by IEPA, monitoring in the watershed is also conducted by the USGS (see Section 2.6).

Increased frequency of monitoring, and expansion of monitoring sites to characterize additional Shoal Creek tributaries, will further allow evaluation of any future water quality concerns. Synoptic stream sampling can be used to better understand sources of pollutants and identify hot spots or additional critical areas. When possible, a variety of flow regimes should be sampled for a range of parameters to improve understanding of water quality concerns and ensure the effectiveness of protection efforts.

There are limited local data on the effectiveness of many BMPs; therefore, monitoring the results of programs and representative practices are critical. BMP monitoring can include quantitative monitoring of physical components (e.g., water quality and flow) qualitative (i.e., visual) monitoring of physical components (e.g., vegetation), and monitoring of behaviors. A monitoring program can be put in place as BMPs are implemented to 1) measure success and 2) identify changes that could be made to increase effectiveness.

5.4 Adaptive Management

Adaptive management is a commonly used strategy to address natural resource management that involves a temporal sequence of decisions (or implementation actions), in which the best action at each decision point depends on the state of the managed system. As a structured iterative implementation process, adaptive management offers the flexibility for responsible parties to monitor implementation actions, determine the success of such actions and ultimately, base management decisions upon the measured results of completed implementation actions and the current state of the system. This process, depicted in Figure 8, enhances the understanding and estimation of predicted outcomes and ensures refinement of necessary activities to better guarantee desirable results. In this way, understanding of the resource can be enhanced over time, and management can be improved.

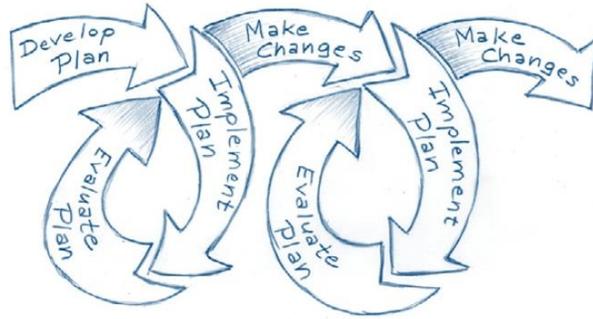


Figure 8. Adaptive management iterative process (U.S. EPA 2008)

While the Stage 1 and 2 documents indicate that Shoal Creek segments (IL_OI-05, IL_OI-13, and IL_OI-15) are recommended for delisting, the protection activities and adaptive management principles outlined in this protection plan should be coordinated to maintain water quality conditions and prevent impairment in the future.

6. Public Participation

A public meeting was held on December 12, 2018 at the Carlyle Lake Visitor Center in Carlyle, IL to present the Stage 1 report and findings. A public notice was placed on the Illinois EPA website. There were many stakeholders present including representatives from the Army Corps of Engineers, the Kaskaskia Watershed Association, Original Kaskaskia Area Wilderness, Inc., and others.

The public comment period closed on January 12, 2019. No written comments were provided on the draft Stage 1 report.

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Appendix A – Stage 1 Report

Shoal Creek Watershed (II) Total Maximum Daily Load

Final Stage 1 Report



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Acronyms and Abbreviations

AFO	animal feeding operation
AWQMN	Ambient Water Quality Monitoring Network
CAFO	confined animal feeding operation
CWA	Clean Water Act
Illinois EPA	Illinois Environmental Protection Agency
IPCB	Illinois Pollution Control Board
MGD	millions of gallons per day
MS4	municipal separate storm sewer system
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
STP	sewage treatment plant
TMDL	total maximum daily load
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WQS	water quality standards

1. Introduction

The Clean Water Act and U.S. Environmental Protection Agency (U.S. EPA) regulations require that Total Maximum Daily Loads (TMDLs) be developed for waters that do not support their designated uses. In simple terms, a TMDL is a plan to attain and maintain water quality standards in waters that are not currently meeting standards. This TMDL study addresses the Shoal Creek watershed in south-central Illinois. The project area, referred to as the Shoal Creek II watershed, is approximately 310 square miles and includes multiple impairments (Figure 1). A TMDL study was previously completed for the Shoal Creek watershed. Relevant information from the study is included herein where applicable (IEPA 2008).

The TMDL process establishes the allowable loading of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and instream conditions. This allowable loading represents the maximum quantity of the pollutant that the waterbody can receive without exceeding water quality standards. The TMDL also includes a margin of safety, which reflects uncertainty as well as the effects of seasonal variation. By following the TMDL process, States can establish water quality-based controls to reduce pollution from both point and nonpoint sources, and restore and maintain the quality of their water resources (U.S. EPA 1991). The Illinois EPA will be working with stakeholders to implement the necessary controls to improve water quality in the impaired waterbodies and meet water quality standards. It should be noted that the controls for nonpoint sources (e.g., agriculture) will be strictly voluntary.

1.1 Water Quality Impairments

Numerous segments are included on the draft 303(d) list of impaired waters; however, only four segments are addressed as part of this project. Segment OI-05 within the Shoal Creek watershed has been placed on the State of Illinois §303(d) list (Table 1 and Figure 1) and requires development of a TMDL. The segment was previously recommended for delisting based on data collected during two periods of continuous monitoring in 2006 as part of the previous completed Shoal Creek TMDL (IEPA 2008). Since the 2006 monitoring, however, water quality standard violations have been observed in this segment.

Table 1. Shoal Creek watershed impairments and pollutants (2016 Illinois 303(d) Draft List)

Name	Segment ID	Segment Length (Miles)	Watershed Area (Sq. Miles)	Designated Uses	Cause of Impairment
Shoal Creek	OI-05	13.37	917	Aquatic Life	Dissolved Oxygen
Shoal Creek	OI-08	14.29	745	Public and Food Processing Water Supply	Iron ^a
Shoal Creek	OI-13	11.49	726	Aquatic Life	Dissolved Oxygen ^b
Shoal Creek	OI-15	11.12	685	Aquatic Life	Dissolved Oxygen ^c

BOLD – TMDLs are addressed in this Stage 1 report.

a. Impairment was removed from the 2018 draft 303(d) list and is not addressed further in this report.

b. Additional data are needed to verify impairment.

c. While recent data show no impairment, the assessment is still undergoing quality control review.

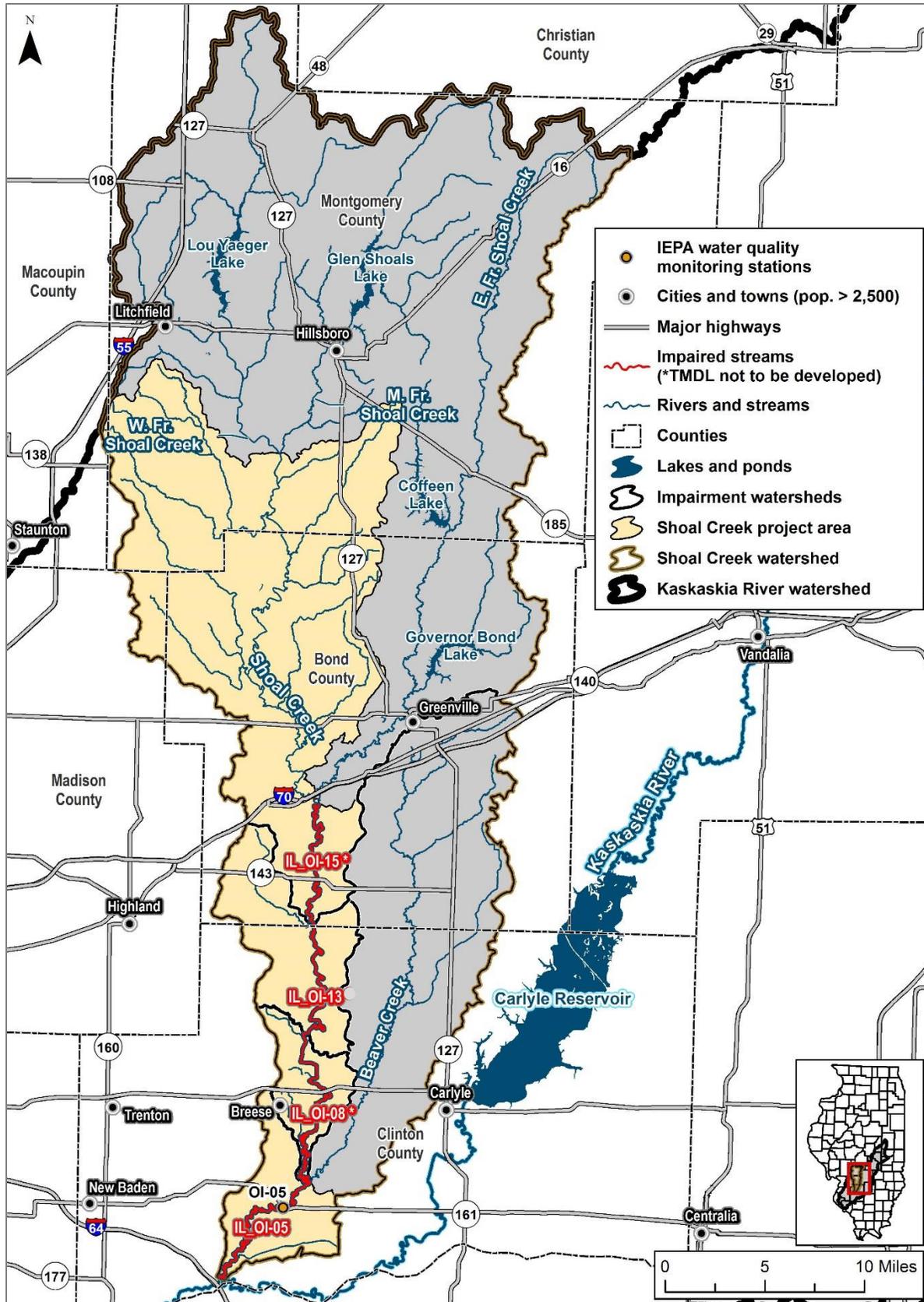


Figure 1. Shoal Creek watershed, TMDL project area.

1.2 TMDL Endpoints

This section presents information on the water quality standards (WQS) that are used for TMDL endpoints. WQS are designed to protect beneficial uses. The authority to designate beneficial uses and adopt WQS is granted through Title 35 of the Illinois Administrative Code. Designated uses to be protected in surface waters of the state are defined under Section 303, and WQS are designated under Section 302 (Water Quality Standards). Designated uses and WQS are discussed below.

1.2.1 Designated Uses

Illinois EPA uses rules and regulations adopted by the Illinois Pollution Control Board (IPCB) to assess the designated use support for Illinois waterbodies. The following are the use support designations provided by the IPCB that apply to waterbodies in the Shoal Creek watershed:

General Use Standards – These standards protect for aquatic life, wildlife, agricultural uses, primary contact (where physical configuration of the waterbody permits it, any recreational or other water use in which there is prolonged and intimate contact with the water involving considerable risk of ingesting water in quantities sufficient to pose a significant health hazard, such as swimming and water skiing), secondary contact (any recreational or other water use in which contact with the water is either incidental or accidental and in which the probability of ingesting appreciable quantities of water is minimal, such as fishing, commercial and recreational boating, and any limited contact incident to shoreline activity), and most industrial uses. These standards are also designed to ensure the aesthetic quality of the state’s aquatic environment.

Shoal Creek segment OI-05 is designated for dissolved oxygen enhanced protection according to 35 Ill Adm. Code 302.206. Waters with enhanced protection have a more stringent dissolved oxygen standard than other waters of the State. These waters were chosen based on the potential biota (fish early life stages present) and the dissolved oxygen needed for these biota to thrive.

1.2.2 Water Quality Standards and TMDL Endpoints

Environmental regulations for the State of Illinois are contained within the Illinois Administrative Code, Title 35. Specifically, Title 35, Part 302 contains water quality standards promulgated by the IPCB. This section presents the standards applicable to impairments within the study area. Water quality standards are the endpoints to be used for TMDL development in the Shoal Creek watershed (Table 2).

Table 2. Summary of water quality standards for the Shoal Creek watershed

Parameter	Units	General Use Water Quality Standard for Waters with Enhanced Protection
Dissolved Oxygen ^a	mg/L	March-July > 5.0 min & > 6.25 7-day mean Aug-Feb > 4.0 min, > 4.5 7-day mean, & > 6.0 30-day mean

a. Applies to the dissolved oxygen concentration in the main body of all streams, in the water above the thermocline of thermally stratified lakes and reservoirs, and in the entire water column of unstratified lakes and reservoirs.

Aquatic life use assessments in streams are typically based on the interpretation of biological information, physicochemical water data and physical-habitat information from the Intensive Basin Survey, Ambient Water Quality Monitoring Network or Facility-Related Stream Survey programs. The primary biological measures used are the fish Index of Biotic Integrity (fIBI; Karr et al. 1986; Smogor 2000, 2005), the macroinvertebrate Index of Biotic Integrity (mIBI; Tetra Tech 2004) and the Macroinvertebrate Biotic Index (MBI; Illinois EPA 1994). Physical habitat information used in assessments includes quantitative or qualitative measures of stream bottom composition and qualitative descriptors of channel and riparian

conditions. Physicochemical water data used include measures of conventional parameters (e.g., dissolved oxygen, pH and temperature), priority pollutants, non-priority pollutants, and other pollutants (U.S. EPA 2002 and <https://www.epa.gov/wqc>). In a minority of streams for which biological information is unavailable, aquatic life use assessments are based primarily on physicochemical water data.

When a stream segment is determined to be Not Supporting aquatic life use, generally, one exceedance of an applicable Illinois WQS (related to the protection of aquatic life) results in identifying the parameter as a potential cause of impairment. Additional guidelines used to determine potential causes of impairment include site-specific standards (35 Ill. Adm. Code 303, Subpart C), or adjusted standards (published in the ICPB's Environmental Register at <http://www.ipcb.state.il.us/ecll/environmentalregister.asp>).

2. Watershed Characterization

The Shoal Creek watershed is located in southwestern Illinois (Figure 1). The headwaters begin in northern Montgomery County and Christian County, IL and flow south towards its confluence with the Kaskaskia River. Shoal Creek joins the Upper Kaskaskia River downstream of Carlyle Lake and the Kaskaskia River eventually joins the Mississippi River south of St. Louis, Missouri. A TMDL has recently been developed for a portion of the Shoal Creek watershed (IEPA 2008) therefore the previous Shoal Creek Watershed TMDL provides the basis for the watershed characterization and source assessment for the Shoal Creek project area below.

2.1 Jurisdictions and Population

Relevant information on jurisdictions and population can be found within the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008). The project area is located within Bond, Montgomery, Clinton, Madison, and Macoupin counties.

2.2 Climate

In general, the climate of southern Illinois is temperate with hot summers and cold, snowy winters. Relevant information on climate can be found within the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008).

2.3 Land Use and Land Cover

Relevant information on land use and land cover can be found within the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008). Cultivated crops make up the majority of the land cover in the project area.

2.4 Topography

Relevant information on topography can be found within the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008).

2.5 Soils

Relevant information on soils can be found within the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008). Soils are primarily category C soils that are defined as “soils having a slow infiltration rate when thoroughly wet” with slow infiltration rates. They typically consist of “soils having

a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture” (IEPA 2008).

2.6 Hydrology

Relevant information on hydrologic conditions can be found within the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008). An active U.S. Geological Survey (USGS) flow gage site is located on the Shoal Creek OI-08 segment (USGS gage 05594000).

2.7 Watershed Studies and Information

Relevant information for this section can be found within the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008). County soil and water conservation districts and health departments were contacted for additional information; no new information was provided.

3. Watershed Source Assessment

Source assessments are an important component of water quality management plans and TMDL development. This section provides a summary of potential sources that contribute to low dissolved oxygen conditions in Shoal Creek.

3.1 Pollutants of Concern

Pollutants of concern evaluated within this source assessment include parameters influencing dissolved oxygen such as biochemical oxygen demand, phosphorus, and ammonia. These pollutants can originate from an array of sources including point and nonpoint sources. Eutrophication (high levels of algae) is also often linked directly to low dissolved oxygen conditions and therefore nutrients are also a pollutant of concern. Point sources typically discharge at a specific location from pipes, outfalls, and conveyance channels. Nonpoint sources are diffuse sources that have multiple routes of entry into surface waters, particularly overland runoff. This section provides a summary of potential point and nonpoint sources that contribute to Shoal Creek.

3.2 Point Sources

Point source pollution is defined by the Federal Clean Water Act (CWA) §502(14) as:

“any discernible, confined and discrete conveyance, including any ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation [CAFO], or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agriculture storm water discharges and return flow from irrigated agriculture.”

Under the CWA, all point sources are regulated under the NPDES program. A municipality, industry, or operation must apply for an NPDES permit if an activity at that facility discharges wastewater to surface water. Point sources can include facilities such as municipal wastewater treatment plants (WWTPs), industrial facilities, CAFOs, or regulated storm water including municipal separate storm sewer systems (MS4s).

There are two individual NPDES permitted facilities in the Shoal Creek (OI-05) watershed—the Germantown Sewage Treatment Plant (STP) (NPDES permit ILG580186) and one CAFO (NPDES

permit ILA010007). There are no permitted MS4s. Germantown STP is a domestic lagoon that discharges to a Shoal Creek tributary with average design flow of 0.135 million gallons per day (MGD) and maximum design flow of 0.330 MGD.

There are three individual NPDES permitted facilities in the Shoal Creek (OI-15) watershed—Pocahontas STP (ILG580010), Pierron East STP (ILG580237), and Louisville STP (ILG580081).

There are no permitted facilities or MS4s in the Shoal Creek (OI-13) watershed.

3.3 Nonpoint Sources

The term nonpoint source pollution is defined as any source of pollution that does not meet the legal definition of point sources. Nonpoint source pollution typically results from overland stormwater runoff that is diffuse in origin, as well as background conditions. Nonpoint pollutant sources potentially contributing to low dissolved oxygen impairments include agricultural runoff, onsite wastewater treatment systems, and animal agriculture activities. As part of the water resource assessment process, Illinois EPA has identified several sources as contributing to the impairments: loss of riparian habitat, crop production (crop land or dry land), and agriculture, all of which are nonpoint sources.

3.3.1 Agricultural Runoff

During wet-weather events (snowmelt and rainfall), pollutants are incorporated into runoff and can be delivered to downstream waterbodies. The resultant pollutant loads are linked to the land uses and practices in the watershed. Agricultural areas can have significant effects on water quality if proper best management practices are not in place, specifically contributing to high biochemical oxygen demand and nutrients that can affect the dissolved oxygen conditions in streams. Drain tiles also transport agricultural runoff directly to ditches and streams, whereas runoff flowing over the land surface may infiltrate to the subsurface and may flow through riparian areas. The majority of land within the Shoal Creek watershed is in cultivated crops.

3.3.2 Onsite Wastewater Treatment Systems

Onsite wastewater treatment systems (e.g., septic systems) that are properly designed and maintained should not serve as a source of contamination to surface waters. However, onsite systems do fail for a variety of reasons. Common soil-type limitations which contribute to failure include seasonally high water tables, compact glacial till, bedrock, and fragipan. When these septic systems fail hydraulically (surface breakouts) or hydrogeologically (inadequate soil filtration) there can be adverse effects to surface waters (Horsley and Witten 1996). Septic systems contain all the water discharged from homes and business and can be significant sources of pollutants.

Illinois EPA estimates that between 20–60% of onsite wastewater treatment systems are failing in the state of Illinois (IEPA 2004). During the development of this TMDL county health departments were contacted for county specific information on septic systems and unsewered communities. Septic systems throughout the watershed are typically inspected during installation and on a complaint basis. There are approximately 20,000 septic systems in Madison County. In 2017, 223 systems were inspected in Madison County and 96.5 percent of systems that were previous found under violation were brought into compliance.

3.3.3 Animal Feeding Operations (AFOs)

Animal feeding operations that are not classified as CAFOs are known as animal feeding operations (AFOs) in Illinois. Non-CAFO AFOs are considered nonpoint sources by U.S. EPA. AFOs in Illinois do not have state permits. However, they are subject to state livestock waste regulations and may be inspected by the Illinois EPA, either in response to complaints or as part of the Agency's field inspection responsibilities to determine compliance by facilities subject to water pollution and livestock waste regulations. The animals raised in AFOs produce manure that is stored in pits, lagoons, tanks and other storage devices. The manure is then applied to area fields as fertilizer. When stored and applied properly, this beneficial re-use of manure provides a natural source for crop nutrition. It also lessens the need for fuel and other natural resources that are used in the production of fertilizer. AFOs, however, can pose environmental concerns, including the following:

- Manure can leak or spill from storage pits, lagoons, tanks, etc.
- Improper application of manure can contaminate surface or ground water.
- Manure over application can adversely impact soil productivity.

Livestock are potential sources of nutrients to streams, particularly when direct access is not restricted and/or where feeding structures are located adjacent to riparian areas. Bond and Clinton SWCDs received a 319 grant from IEPA in 2016 to continue work in the two counties assisting livestock producers in making improvements to their animal waste systems to reduce nutrient and sediment loading to waterbodies.

4. Water Quality

An important step in the TMDL development process is the review of water quality conditions, particularly data and information used to list segments. Examination of water quality monitoring data is a key part of defining the problem that the TMDL is intended to address.

Background information on water quality monitoring can be found in the recently completed Shoal Creek Total Maximum Daily Load (IEPA 2008). In the Shoal Creek watershed, water quality data were found for numerous stations that are part of the Illinois EPA Ambient Water Quality Monitoring Network (AWQMN). Parameters sampled in the streams include field measurements (e.g., dissolved oxygen) as well as those that require lab analyses (e.g., nutrients).

The most recent 10 years of data collection, 2007–2016, were used to evaluate impairment status. Data that are greater than 10 years old are not included in impairment status evaluation; however, data from 2002 were available for segment OI-05. Each data point was reviewed to ensure the use of quality data in the analysis below. Data were obtained directly from Illinois EPA.

4.1 Shoal Creek (OI-05)

Shoal Creek (OI-05) is impaired for aquatic life due to low levels of dissolved oxygen. One Illinois EPA sampling site is present on segment OI-05 of Shoal Creek (Table 3 and Figure 2). Ten samples were collected at the site from 2007–2012. Four violations of the general use water quality standard – enhanced protection were observed in June and August 2007 and July of 2012. Continuous dissolved oxygen data were collected in 2007 and 2017; multiple violations of the standard were observed in July and August 2007 (Figure 3). These violations verify impairment.

Table 3. Data summary, Shoal Creek OI-05

Sample Site	No. of samples	Minimum (mg/L)	Average (mg/L)	Maximum (mg/L)	Number of exceedances of general use water quality standard – enhanced protection (>5 mg/L (Mar-Jul) and >4 mg/L (Aug-Feb))
OI-05	10	3.1	5.4	8.8	4

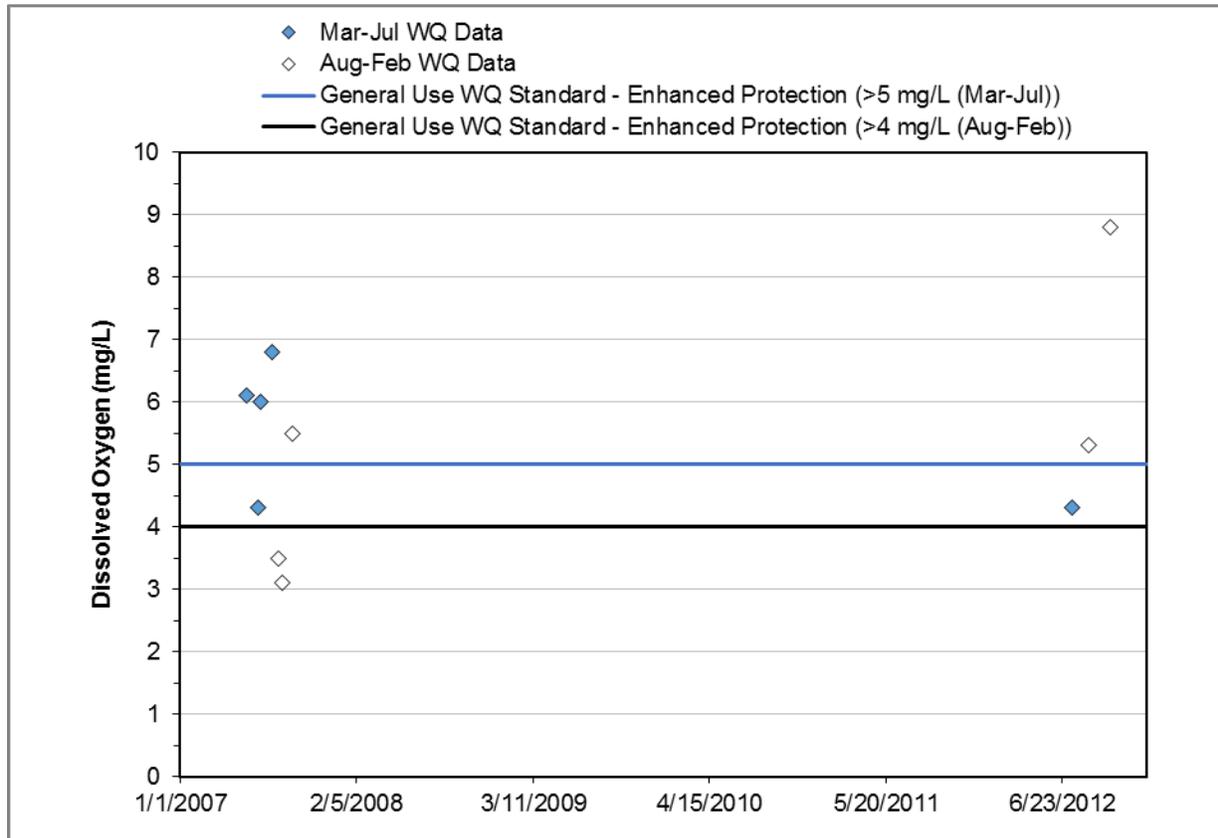


Figure 2. Dissolved oxygen water quality time series, Shoal Creek OI-05.

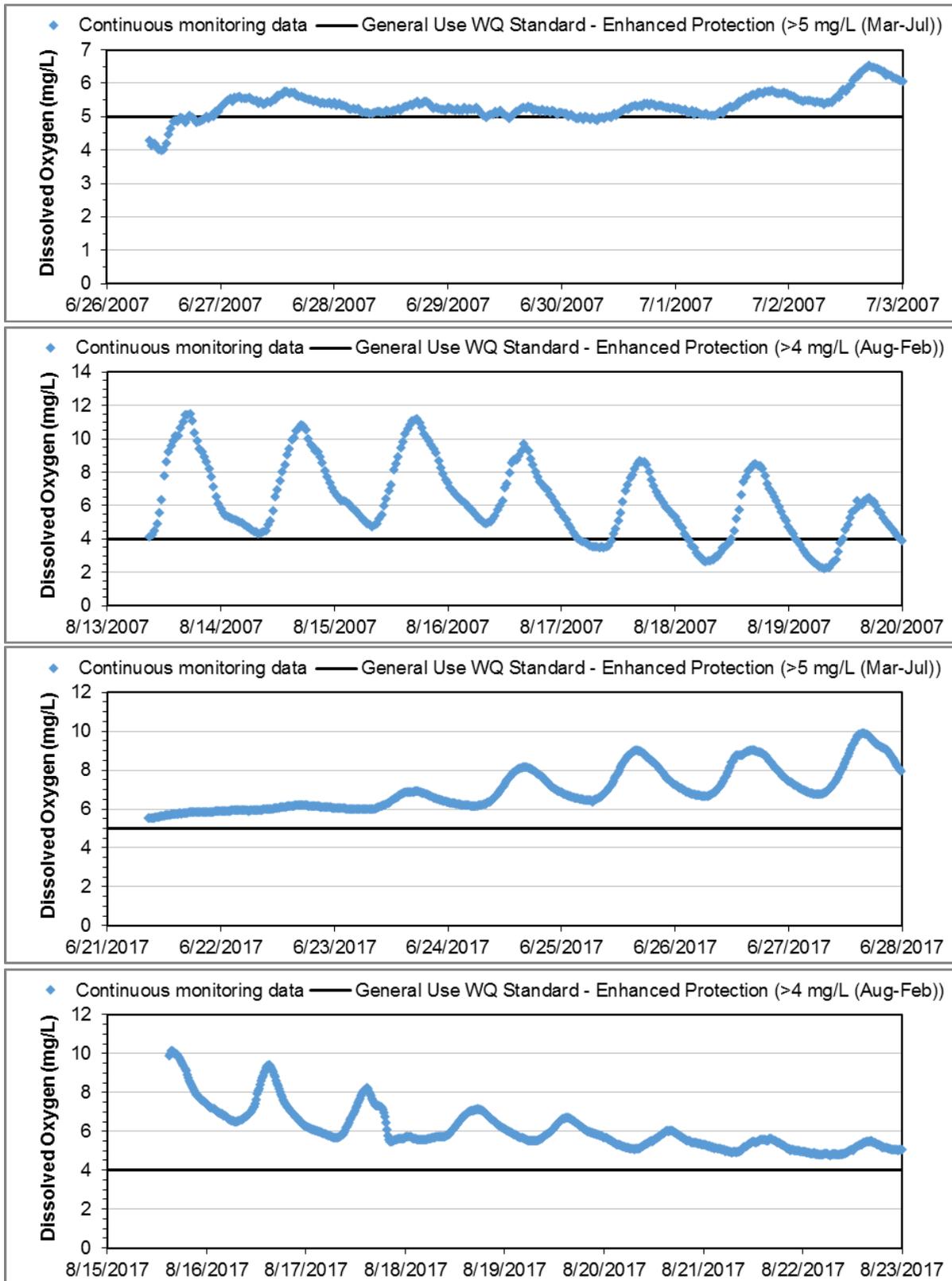


Figure 3. Continuous water quality time series for dissolved oxygen, Shoal Creek OI-05 segment.

Further review of available data was conducted to determine the cause of impairment:

- **Point Sources:** The point source discharging into Shoal Creek is downstream from the monitoring station (OI-05) and is therefore not contributing to the impairment.
- **Eutrophication:** Available phosphorus data were evaluated to determine if eutrophication was contributing to low dissolved oxygen conditions; however, no eutrophication relationship exists between high levels of phosphorus and low levels of dissolved oxygen (Figure 4).

Although the impairment has been verified, a strong link to a pollutant is not present and there are no point sources contributing to the impairment that has been assessed based on data at OI-05.

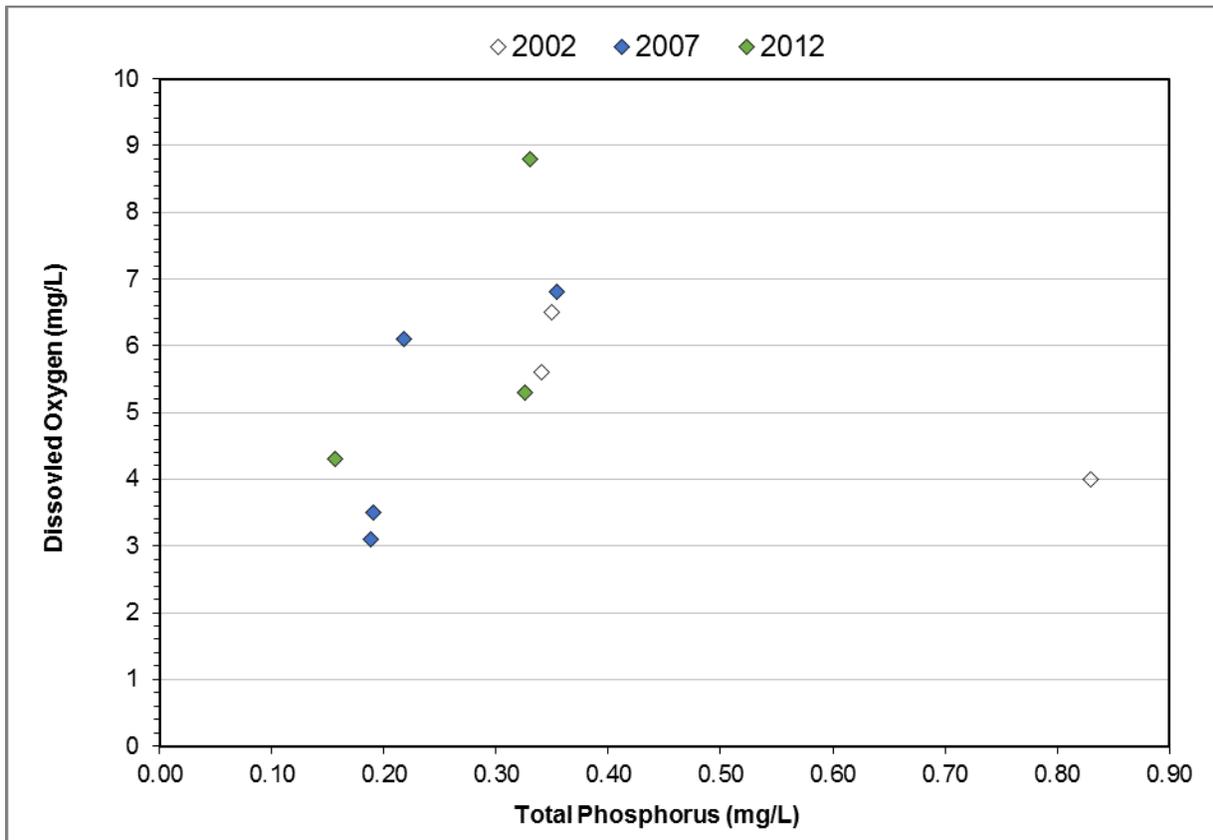


Figure 4. Total phosphorus verse dissolved oxygen, Shoal Creek OI-05.

4.2 Shoal Creek (OI-13)

Shoal Creek segment OI-13 is listed as impaired for aquatic life due to dissolved oxygen. One IEPA sampling site (OI-13) was identified on the segment. Data collection between 2007–2016 does not indicate impairment in the segment (Figure 5); however, due to the small sample size, additional data are needed to verify impairment.

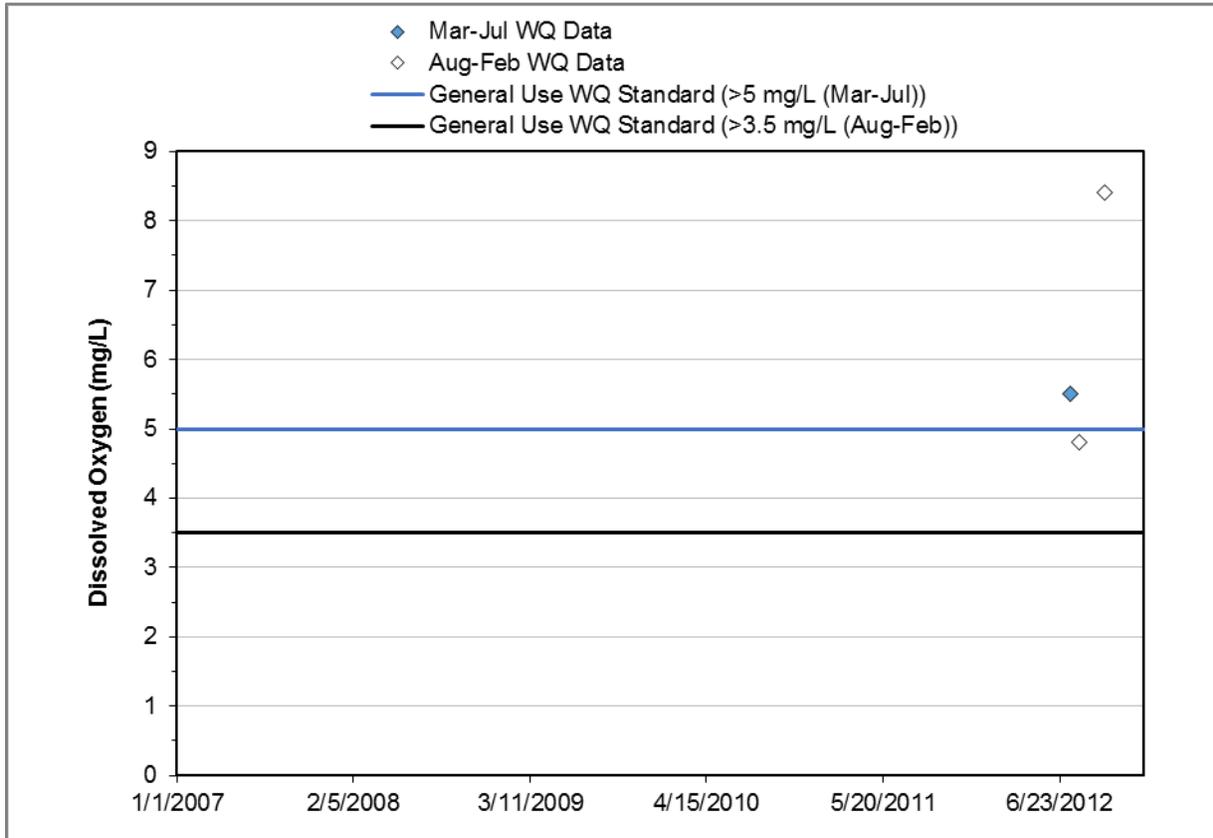


Figure 5. Dissolved oxygen water quality time series, Shoal Creek OI-13.

4.3 Shoal Creek (OI-15)

Shoal Creek segment OI-15 is listed as impaired for aquatic life due to dissolved oxygen. One IEPA sampling site was identified on the segment, OI-15. Data collection between 2007–2012 (Figure 6) and continuous data from June and August 2017 (Figure 7) do not indicate impairment. While the data do not show impairment, the assessment is still undergoing quality control review.

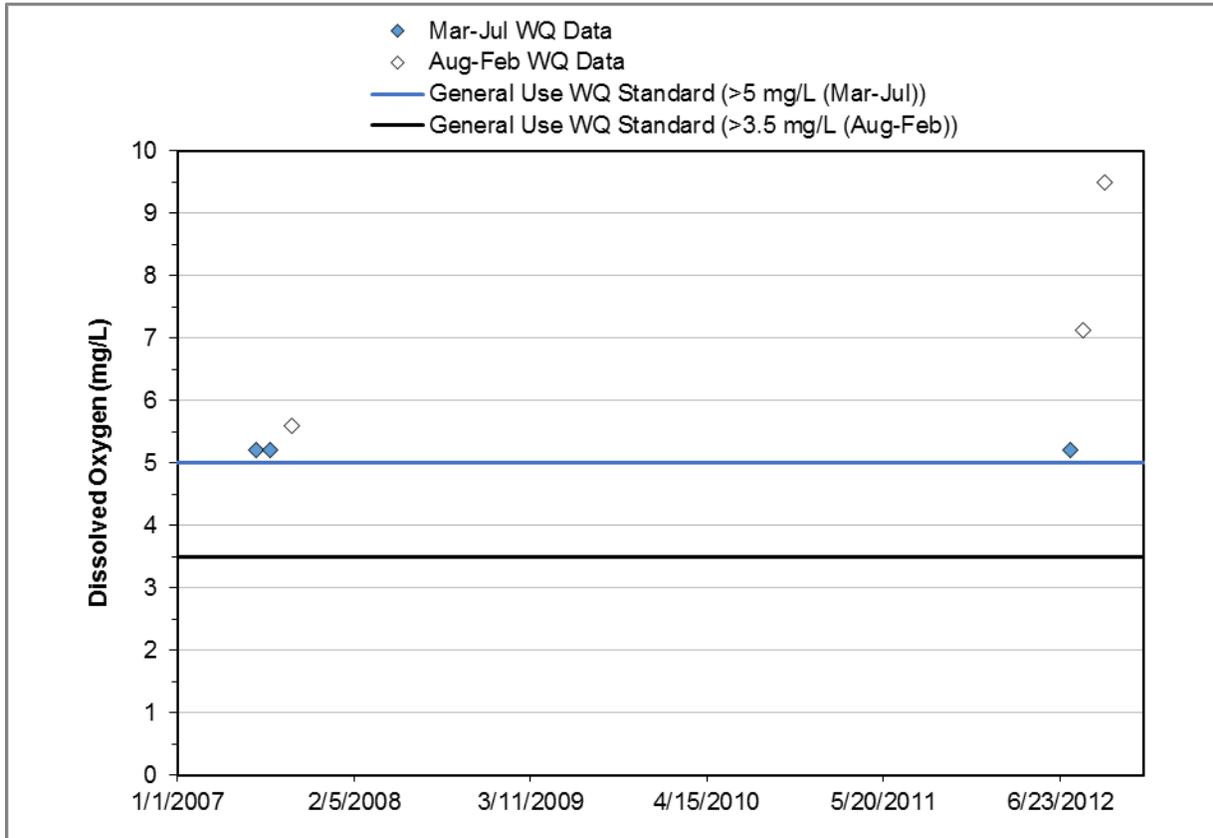


Figure 6. Dissolved oxygen water quality time series, Shoal Creek OI-15.

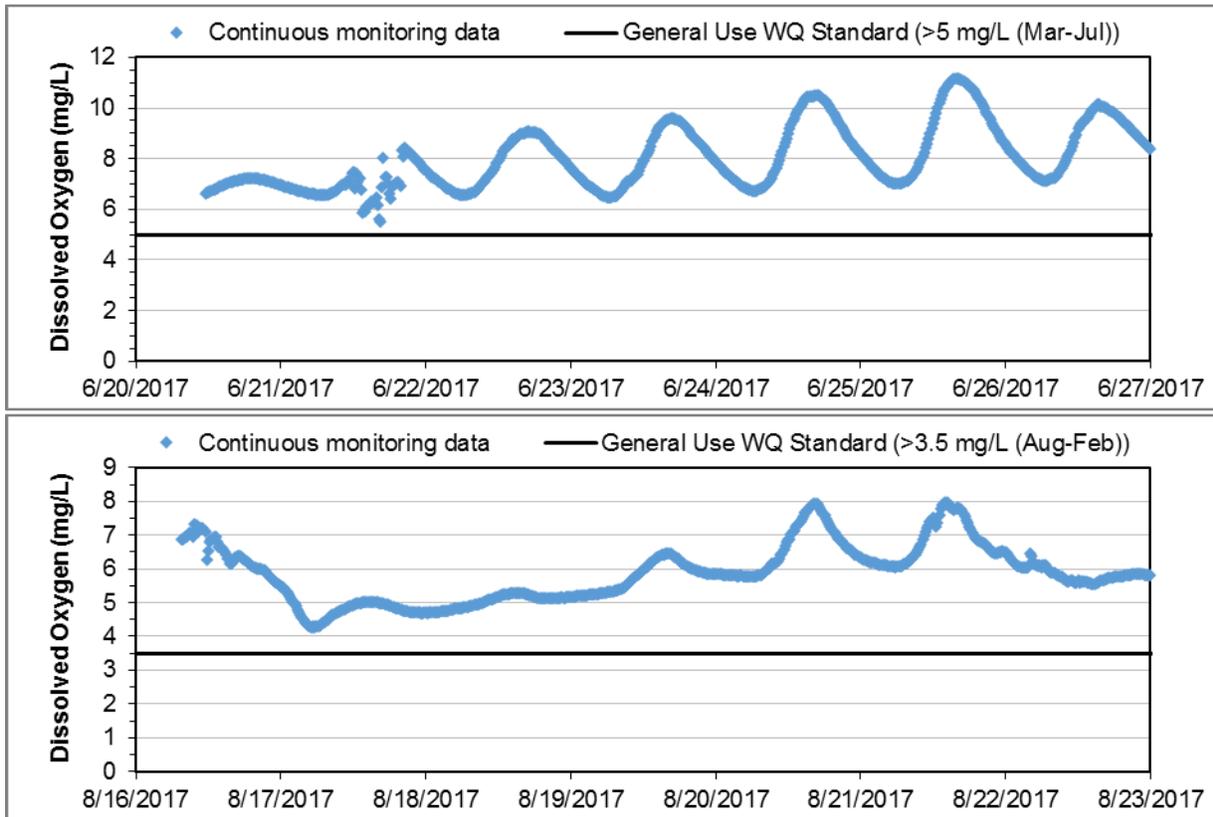


Figure 7. Continuous water quality time series for dissolved oxygen, Shoal Creek OI-15 segment.

5. TMDL Methods and Data Needs

The first stage of this project assesses available data followed by evaluation of their credibility. The types of data available, their quantity and quality, and their spatial and temporal coverage relative to impaired segments or watersheds drive the approaches used for TMDL model selection and analysis. Credible data are those that meet specified levels of data quality, with acceptance criteria defined by measurement quality objectives, specifically their precision, accuracy, bias, representativeness, completeness, and reliability. The following sections describe the methods that will be used to derive TMDLs and the additional data needed to develop credible TMDLs.

5.1 TMDL Methods

TMDLs are proposed for segments with verified impairments and known pollutants (Table 4). If point sources are not present and if there is a correlation with eutrophication (i.e., phosphorus concentration or high levels of algae and/or plant growth), a duration curve approach is suggested to develop a phosphorus TMDL. The phosphorus target will be derived from the relationship between phosphorus and dissolved oxygen in the impaired stream. TMDLs are not proposed for dissolved oxygen impairments that are not affected by point sources and do not show a correlation with eutrophication. In these cases, it is assumed that the cause of impairment is non-pollutant based (e.g., the effect of lack of re-aeration in low-gradient streams or the effect of hydromodification).

Table 4. Proposed model summary

Name	Segment ID	Designated Uses	TMDL Parameter(s)	Proposed Model	Proposed Pollutant
Shoal Creek	OI-05	Aquatic life	Dissolved Oxygen	4C classification	Non-pollutant
Shoal Creek	OI-13	Aquatic life	Dissolved Oxygen	Load duration curve or 4C classification, pending impairment verification	Phosphorus or non-pollutant, pending impairment verification

The primary benefit of duration curves in TMDL development is to provide insight regarding patterns associated with hydrology and water quality concerns. The duration curve approach is particularly applicable because water quality is often a function of stream flow. For instance, sediment concentrations typically increase with rising flows as a result of factors such as channel scour from higher velocities. Other parameters, such as chloride, may be more concentrated at low flows and more diluted by increased water volumes at higher flows. The use of duration curves in water quality assessment creates a framework that enables data to be characterized by flow conditions. The method provides a visual display of the relationship between stream flow and water quality.

Allowable pollutant loads have been determined through the use of load duration curves. Discussions of load duration curves are presented in *An Approach for Using Load Duration Curves in the Development of TMDLs* (U.S. EPA 2007). This approach involves calculating the allowable loadings over the range of flow conditions expected to occur in the impaired stream by taking the following steps:

1. A flow duration curve for the stream is developed by generating a flow frequency table and plotting the data points to form a curve. The data reflect a range of natural occurrences from extremely high flows to extremely low flows.
2. The flow curve is translated into a load duration (or TMDL) curve by multiplying each flow value (in cubic feet per second) by the water quality standard/target for a contaminant (mg/L), then multiplying by conversion factors to yield results in the proper unit (i.e., pounds per day). The resulting points are plotted to create a load duration curve.
3. Each water quality sample is converted to a load by multiplying the water quality sample concentration by the average daily flow on the day the sample was collected. Then, the individual loads are plotted as points on the TMDL graph and can be compared to the water quality standard/target, or load duration curve.
4. Points plotting above the curve represent deviations from the water quality standard/target and the daily allowable load. Those plotting below the curve represent compliance with standards and the daily allowable load. Further, it can be determined which locations contribute loads above or below the water quality standard/target.
5. The area beneath the TMDL curve is interpreted as the loading capacity of the stream. The difference between this area and the area representing the current loading conditions is the load that must be reduced to meet water quality standards/targets.
6. The final step is to determine where reductions need to occur. Those exceedances at the right side of the graph occur during low flow conditions, and may be derived from sources such as illicit sewer connections. Exceedances on the left side of the graph occur during higher flow events, and may be derived from sources such as runoff. Using the load duration curve approach allows Illinois EPA to

determine which implementation practices are most effective for reducing loads on the basis of flow regime.

Water quality duration curves are created using the same steps as those used for load duration curves except that concentrations, rather than loads, are plotted on the vertical axis. Flows are categorized into the following five hydrologic zones (U.S. EPA 2007):

- High flow zone: stream flows that plot in the 0 to 10-percentile range, related to flood flows
- Moist zone: flows in the 10 to 40-percentile range, related to wet weather conditions
- Mid-range zone: flows in the 40 to 60-percentile range, median stream flow conditions
- Dry zone: flows in the 60 to 90-percentile range, related to dry weather flows
- Low flow zone: flows in the 90 to 100-percentile range, related to drought conditions

The duration curve approach helps to identify the issues surrounding the impairment and to roughly differentiate among sources. Table 5 summarizes the general relationship among the five hydrologic zones and potentially contributing source areas (the table is not specific to an individual pollutant). For example, the table indicates that impacts from point sources are usually most pronounced during dry and low flow zones because there is less water in the stream to dilute their loads. In contrast, impacts from stormwater are most pronounced during moist and high flow zones due to increased overland flow from stormwater source areas during rainfall events.

Table 5. Relationship between duration curve zones and contributing sources

Contributing source area	Duration Curve Zone				
	High	Moist	Mid-range	Dry	Low
Point source				M	H
Livestock direct access to streams				M	H
On-site wastewater systems	M	M-H	H	H	H
Stormwater: Impervious		H	H	H	
Stormwater: Upland	H	H	M		
Field drainage: Natural condition	H	M			
Field drainage: Tile system	H	H	M-H	L-M	

Note: Potential relative importance of source area to contribute loads under given hydrologic condition (H: High; M: Medium; L: Low).

The load reduction approach also considers critical conditions and seasonal variation in the TMDL development as required by the Clean Water Act and U.S. EPA's implementing regulations. Because the approach establishes loads on the basis of a representative flow regime, it inherently considers seasonal variations and critical conditions attributed to flow conditions. An underlying premise of the duration curve approach is correlation of water quality impairments to flow conditions. The duration curve alone does not consider specific fate and transport mechanisms, which may vary depending on watershed or pollutant characteristics.

5.2 Additional Data Needs

Data satisfy two key objectives for Illinois EPA, enabling the agency to make informed decisions about the resource. These objectives include developing information necessary to:

- Determine if the impaired areas are meeting applicable water quality standards for their respective designated use(s)

- Support modeling and assessment activities required to allocate pollutant loadings for all impaired areas where water quality standards are not being met

Additional data may be needed to verify impairment, understand probable sources, calculate reductions, develop calibrated water quality models, and develop effective implementation plans. Table 6 summarizes the additional data needed for each impaired segment.

Table 6. Additional data needs

Name	Segment ID	Designated Uses	TMDL Parameters	Additional Data Needs
Shoal Creek	OI-05	Aquatic Life	Dissolved Oxygen	To determine relationship with eutrophication
Shoal Creek	OI-13	Aquatic Life	Dissolved Oxygen	To verify impairment and determine relationship with eutrophication
All	All	All	All	Implementation plan development

Specific data needs include:

Additional data collection on Shoal Creek (OI-05)—If additional data are necessary for 4C classification, collect DO, chlorophyll-*a*, and TP grab samples at station OI-05; two samples per day (one per day in the early morning) on three separate sampling days, during the warm summer months and during low flows.

Additional data collection on Shoal Creek (OI-13)—To verify impairment, preferably collect continuous dissolved oxygen data at OI-13 for 7 days during low flow conditions. Alternatively, collect DO, chlorophyll-*a*, and TP grab samples at station OI-13; two samples per day (one per day in the early morning) on three separate sampling days, during the warm summer months and during low flows. This grab sampling will also satisfy the monitoring needs to determine the relationship with eutrophication and evaluate 4C classification.

Additional field-based monitoring—Further in-field assessment can help to better determine the sources of impairments and develop an effective TMDL implementation plan. Additional monitoring for impaired waterbodies includes:

- Wind shield surveys
- Streambank survey and stream assessment for Shoal Creek (OI-05 and OI-13) and associated pollutants (phosphorus or non-pollutant, pending TMDL approach)
- Farmer/landowner surveys
- Word of mouth and in-person conversations with local stakeholders and landowners

6. Public Participation

A public meeting was held on December 12, 2018 at the Carlyle Lake Visitor Center in Carlyle, IL to present the Stage 1 report and findings. A public notice was placed on the Illinois EPA website. There were many stakeholders present including representatives from the Army Corps of Engineers, the Kaskaskia Watershed Association, Original Kaskaskia Area Wilderness, Inc., and others. The public comment period closed on January 12, 2019. No written comments were provided on the draft Stage 1 report.

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Appendix B – Stage 2 Laboratory Results



Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-13 Received: 09/25/19 08:45 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C: 3.00
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190923INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: TOTAL Collected By: MFS Lab Sample ID: **1910970-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/23/19 15:45
Sample Fraction: Total Chlorophyll volume filtered (ml): Sample Depth:

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1

Prepared: 10/21/19 10:00

Units: mg/L

Analyzed: 10/22/19 10:15

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Phosphorus as P	0.246	Q	0.0050	0.0042

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Test results meet all requirements of NELAC (accredited by Florida DOH #E37645). If you have any questions about this report, please contact Tom Weiss, Laboratory Manager, at 217.782.9780.

Reported:
10/29/19 14:59
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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-13 Received : 09/25/19 08:45 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C: 3.00
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190923INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

- Q Maximum holding time exceeded.
- ND Analyte NOT DETECTED at or above the method detection limit
- * Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Reported:
10/29/19 14:59
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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-05 Received: 09/25/19 08:45 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190923INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: CHLOROPHYLL Collected By: MFS/VIT Lab Sample ID: **1910992-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/23/19 15:10
Sample Fraction: Total Chlorophyll volume filtered (ml): 100 Sample Depth:

Chlorophyll by Standard Method 10200 H

Method: 10200 H

Prepared: 09/30/19 12:01

Units: ug/L

Analyzed: 10/03/19 10:31

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Chlorophyll-A (corr)	32.0		0.50	
Chlorophyll-A (unco)	37.5		0.50	
Chlorophyll-B	1.25		0.50	
Chlorophyll-C	4.05		0.50	
Pheophytin-A	7.21		0.50	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety. Test results meet all requirements of NELAC (accredited by Florida DOH #E37645). If you have any questions about this report, please contact Tom Weiss, Laboratory Manager, at 217.782.9780.

Reported:
10/15/19 11:21
Page 1 of 2



Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-05 Received : 09/25/19 08:45 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190923INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

* Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-05 Received: 09/25/19 08:45 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190923INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: CHLOROPHYLL Collected By: MFS/VIT Lab Sample ID: **1910994-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/23/19 11:40
Sample Fraction: Total Chlorophyll volume filtered (ml): 200 Sample Depth:

Chlorophyll by Standard Method 10200 H

Method: 10200 H

Prepared: 09/30/19 12:01

Units: ug/L

Analyzed: 10/03/19 10:31

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Chlorophyll-A (corr)	18.7		0.50	
Chlorophyll-A (unco)	22.2		0.50	
Chlorophyll-B	0.97		0.50	
Chlorophyll-C	1.99		0.50	
Pheophytin-A	4.67		0.50	

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-05 Received : 09/25/19 08:45 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190923INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

* Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-13 Received: 09/25/19 08:45 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190923INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: CHLOROPHYLL Collected By: MFS Lab Sample ID: **1910995-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/23/19 15:45
Sample Fraction: Total Chlorophyll volume filtered (ml): 200 Sample Depth:

Chlorophyll by Standard Method 10200 H

Method: 10200 H

Prepared: 09/30/19 12:01

Units: ug/L

Analyzed: 10/03/19 10:31

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Chlorophyll-A (corr)	129		0.50	
Chlorophyll-A (unco)	140		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	20.2		0.50	
Pheophytin-A	9.75		0.50	

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Reported:

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Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code: OI-13 Received : 09/25/19 08:45 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190923INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

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Report Authorized by:

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Reported:
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Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code: OI-13 Received: 09/25/19 08:45 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190923INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: CHLOROPHYLL Collected By: MFS Lab Sample ID: **1910997-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/23/19 12:20
Sample Fraction: Total Chlorophyll volume filtered (ml): 100 Sample Depth:

Chlorophyll by Standard Method 10200 H

Method: 10200 H

Prepared: 09/30/19 12:01

Units: ug/L

Analyzed: 10/03/19 10:31

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Chlorophyll-A (corr)	254		0.50	
Chlorophyll-A (unco)	286		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	38.1		0.50	
Pheophytin-A	37.9		0.50	

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Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code: OI-13 Received : 09/25/19 08:45 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190923INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-05 Received: 10/02/19 11:00 by Scott Clark
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C: 2.00
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190930INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: TOTAL Collected By: MFS Lab Sample ID: **19J0089-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/30/19 12:02
Sample Fraction: Total Chlorophyll volume filtered (ml): Sample Depth:

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1

Prepared: 10/22/19 09:00

Units: mg/L

Analyzed: 10/22/19 17:18

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Phosphorus as P	0.196		0.0050	0.0042

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Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code:	OI-05	Received :	10/02/19 11:00	by	Scott Clark
Waterbody Name:	SHOAL CREEK	County:	CLINTON	Temperature C:	2.00
Funding Code:	WP06	Monitoring Unit:	TMDL		
Trip ID:	20190930INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

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Report Authorized by:

Tom Weiss
Laboratory Manager

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-05 Received: 10/02/19 11:00 by Scott Clark
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C: 2.00
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190930INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: TOTAL Collected By: MFS Lab Sample ID: **19J0090-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/30/19 15:10
Sample Fraction: Total Chlorophyll volume filtered (ml): Sample Depth:

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1

Prepared: 10/22/19 09:00

Units: mg/L

Analyzed: 10/22/19 17:19

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Phosphorus as P	0.187		0.0050	0.0042

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Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code:	OI-05	Received :	10/02/19 11:00	by	Scott Clark
Waterbody Name:	SHOAL CREEK	County:	CLINTON	Temperature C:	2.00
Funding Code:	WP06	Monitoring Unit:	TMDL		
Trip ID:	20190930INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

* Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-13 Received: 10/02/19 11:00 by Scott Clark
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C: 2.00
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190930INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: TOTAL Collected By: VIT Lab Sample ID: **19J0091-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/30/19 12:48
Sample Fraction: Total Chlorophyll volume filtered (ml): Sample Depth:

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1

Prepared: 10/22/19 09:00

Units: mg/L

Analyzed: 10/22/19 17:19

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Phosphorus as P	0.116		0.0050	0.0042

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Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code: OI-13 Received : 10/02/19 11:00 by Scott Clark
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C: 2.00
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190930INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

* Non-NELAP accredited

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Tom Weiss
Laboratory Manager

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-13 Received: 10/02/19 11:00 by Scott Clark
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C: 2.00
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190930INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: TOTAL Collected By: VIT Lab Sample ID: **19J0092-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/30/19 16:00
Sample Fraction: Total Chlorophyll volume filtered (ml): Sample Depth:

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1 Prepared: 10/24/19 11:00
Units: mg/L Analyzed: 10/24/19 15:04

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Phosphorus as P	0.107		0.0050	0.0042

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Reported:
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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OI-13	Received :	10/02/19 11:00	by	Scott Clark
Waterbody Name:	SHOAL CREEK	County:	CLINTON	Temperature C:	2.00
Funding Code:	WP06	Monitoring Unit:	TMDL		
Trip ID:	20190930INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

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Laboratory Manager

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-05 Received: 10/02/19 11:00 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190930INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: CHLOROPHYLL Collected By: MFS Lab Sample ID: **19J0104-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/30/19 12:02
Sample Fraction: Total Chlorophyll volume filtered (ml): 150 Sample Depth:

Chlorophyll by Standard Method 10200 H

Method: 10200 H

Prepared: 10/07/19 14:15

Units: ug/L

Analyzed: 10/10/19 10:23

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Chlorophyll-A (corr)	19.6		0.50	
Chlorophyll-A (unco)	30.8		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	ND		0.50	
Pheophytin-A	16.6		0.50	

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Reported:

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-05 Received : 10/02/19 11:00 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190930INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-05 Received: 10/02/19 11:00 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190930INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: CHLOROPHYLL Collected By: MFS Lab Sample ID: **19J0105-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/30/19 15:10
Sample Fraction: Total Chlorophyll volume filtered (ml): 150 Sample Depth:

Chlorophyll by Standard Method 10200 H

Method: 10200 H

Prepared: 10/07/19 14:15

Units: ug/L

Analyzed: 10/10/19 10:23

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Chlorophyll-A (corr)	23.1		0.50	
Chlorophyll-A (unco)	27.4		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	0.73		0.50	
Pheophytin-A	5.52		0.50	

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-05 Received : 10/02/19 11:00 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190930INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

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Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code: OI-13 Received: 10/02/19 11:00 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190930INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: CHLOROPHYLL Collected By: VIT Lab Sample ID: **19J0106-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/30/19 12:48
Sample Fraction: Total Chlorophyll volume filtered (ml): 200 Sample Depth:

Chlorophyll by Standard Method 10200 H

Method: 10200 H

Prepared: 10/07/19 14:15

Units: ug/L

Analyzed: 10/10/19 10:23

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Chlorophyll-A (corr)	16.0		0.50	
Chlorophyll-A (unco)	19.4		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	0.72		0.50	
Pheophytin-A	4.54		0.50	

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LABORATORY RESULTS

Station Code: OI-13 Received : 10/02/19 11:00 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190930INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-13 Received: 10/02/19 11:00 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190930INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: CHLOROPHYLL Collected By: VIT Lab Sample ID: **19J0107-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/30/19 16:00
Sample Fraction: Total Chlorophyll volume filtered (ml): 200 Sample Depth:

Chlorophyll by Standard Method 10200 H

Method: 10200 H

Prepared: 10/07/19 14:15

Units: ug/L

Analyzed: 10/10/19 10:23

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Chlorophyll-A (corr)	14.7		0.50	
Chlorophyll-A (unco)	16.0		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	0.75		0.50	
Pheophytin-A	1.20		0.50	

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Reported:
10/16/19 14:35
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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OI-13	Received :	10/02/19 11:00	by	Amber Royster
Waterbody Name:	SHOAL CREEK	County:	CLINTON	Temperature C:	
Funding Code:	WP06	Monitoring Unit:	TMDL		
Trip ID:	20190930INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

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Laboratory Manager

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10/16/19 14:35

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-05 Received: 10/08/19 16:20 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C: 3.00
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20191007INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: TOTAL Collected By: MFS Lab Sample ID: **19J0358-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 10/08/19 11:53
Sample Fraction: Total Chlorophyll volume filtered (ml): Sample Depth:

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1

Prepared: 10/29/19 08:00

Units: mg/L

Analyzed: 10/29/19 16:10

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Phosphorus as P	0.136		0.0050	0.0042

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Reported:
11/07/19 15:34
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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OI-05	Received :	10/08/19 16:20	by	Amber Royster
Waterbody Name:	SHOAL CREEK	County:	CLINTON	Temperature C:	3.00
Funding Code:	WP06	Monitoring Unit:	TMDL		
Trip ID:	20191007INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

* Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-05 Received: 10/08/19 16:20 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C: 3.00
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20191007INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: TOTAL Collected By: MFS/VIT Lab Sample ID: **19J0359-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 10/08/19 14:40
Sample Fraction: Total Chlorophyll volume filtered (ml): Sample Depth:

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1

Prepared: 10/29/19 08:00

Units: mg/L

Analyzed: 10/29/19 16:10

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Phosphorus as P	0.134		0.0050	0.0042

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-05 Received : 10/08/19 16:20 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C: 3.00
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20191007INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

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Report Authorized by:

Tom Weiss
Laboratory Manager

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LABORATORY RESULTS

Station Code: OI-05 Received: 10/08/19 16:20 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20191007INHS Visit Number: 001 Monitoring Program: TMDL

Client Sample ID: CHLOROPHYLL Collected By: MFS/CDT Lab Sample ID: **19J0360-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 10/07/19 14:40
Sample Fraction: Total Chlorophyll volume filtered (ml): 200 Sample Depth:

Chlorophyll by Standard Method 10200 H

Method: 10200 H

Prepared: 10/16/19 08:09

Units: ug/L

Analyzed: 10/17/19 10:18

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Chlorophyll-A (corr)	9.34		0.50	
Chlorophyll-A (unco)	12.5		0.50	
Chlorophyll-B	0.86		0.50	
Chlorophyll-C	ND		0.50	
Pheophytin-A	4.67		0.50	

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Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code: OI-05 Received : 10/08/19 16:20 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20191007INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

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Report Authorized by:

Tom Weiss
Laboratory Manager

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LABORATORY RESULTS

Station Code: OI-05 Received: 10/08/19 16:20 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20191007INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: CHLOROPHYLL Collected By: MFS Lab Sample ID: **19J0361-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 10/07/19 11:53
Sample Fraction: Total Chlorophyll volume filtered (ml): 200 Sample Depth:

Chlorophyll by Standard Method 10200 H

Method: 10200 H

Prepared: 10/16/19 08:09

Units: ug/L

Analyzed: 10/17/19 10:18

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Chlorophyll-A (corr)	5.34		0.50	
Chlorophyll-A (unco)	7.98		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	ND		0.50	
Pheophytin-A	4.00		0.50	

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LABORATORY RESULTS

Station Code: OI-05 Received : 10/08/19 16:20 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20191007INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

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Laboratory Manager

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Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code: OI-13 Received: 10/08/19 16:20 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20191007INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: CHLOROPHYLL Collected By: VIT Lab Sample ID: **19J0364-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 10/08/19 13:38
Sample Fraction: Total Chlorophyll volume filtered (ml): 200 Sample Depth:

Chlorophyll by Standard Method 10200 H

Method: 10200 H

Prepared: 10/16/19 08:09

Units: ug/L

Analyzed: 10/17/19 10:18

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Chlorophyll-A (corr)	4.00		0.50	
Chlorophyll-A (unco)	5.09		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	0.56		0.50	
Pheophytin-A	1.60		0.50	

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Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code: OI-13 Received : 10/08/19 16:20 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20191007INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

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LABORATORY RESULTS

Station Code: OI-13 Received: 10/08/19 16:20 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20191007INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: CHLOROPHYLL Collected By: MFS Lab Sample ID: **19J0365-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 10/08/19 9:20
Sample Fraction: Total Chlorophyll volume filtered (ml): 200 Sample Depth:

Chlorophyll by Standard Method 10200 H

Method: 10200 H

Prepared: 10/16/19 08:09

Units: ug/L

Analyzed: 10/17/19 10:18

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Chlorophyll-A (corr)	2.67		0.50	
Chlorophyll-A (unco)	3.48		0.50	
Chlorophyll-B	ND		0.50	
Chlorophyll-C	ND		0.50	
Pheophytin-A	1.07		0.50	

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LABORATORY RESULTS

Station Code: OI-13 Received : 10/08/19 16:20 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C:
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20191007INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

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LABORATORY RESULTS

Station Code: OI-05 Received: 09/25/19 08:45 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C: 3.00
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190923INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: TOTAL Collected By: MFS/VIT Lab Sample ID: **1910967-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/24/19 11:40
Sample Fraction: Total Chlorophyll volume filtered (ml): Sample Depth:

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1

Prepared: 10/21/19 10:00

Units: mg/L

Analyzed: 10/22/19 11:06

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Phosphorus as P	0.192		0.0050	0.0042

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code:	OI-05	Received :	09/25/19 08:45	by	Amber Royster
Waterbody Name:	SHOAL CREEK	County:	CLINTON	Temperature C:	3.00
Funding Code:	WP06	Monitoring Unit:	TMDL		
Trip ID:	20190923INHS	Visit Number:	001	Monitoring Program:	TMDL

Notes and Definitions

ND Analyte NOT DETECTED at or above the method detection limit

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Illinois Environmental Protection Agency Laboratory

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LABORATORY RESULTS

Station Code: OI-05 Received: 09/25/19 08:45 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C: 3.00
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190923INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: TOTAL Collected By: MFS/VIT Lab Sample ID: **1910968-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/23/19 15:10
Sample Fraction: Total Chlorophyll volume filtered (ml): Sample Depth:

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1

Prepared: 10/21/19 10:00

Units: mg/L

Analyzed: 10/22/19 10:14

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Phosphorus as P	0.214	Q	0.0050	0.0042

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LABORATORY RESULTS

Station Code: OI-05 Received : 09/25/19 08:45 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C: 3.00
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190923INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

- Q Maximum holding time exceeded.
- ND Analyte NOT DETECTED at or above the method detection limit
- * Non-NELAP accredited

Report Authorized by:

Tom Weiss
Laboratory Manager

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Illinois Environmental Protection Agency Laboratory

825 N. Rutledge Springfield, Illinois 62702 217.782.9780

LABORATORY RESULTS

Station Code: OI-13 Received: 09/25/19 08:45 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C: 3.00
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190923INHS Visit Number: 001 Monitoring Program: TMDL
Client Sample ID: TOTAL Collected By: MFS Lab Sample ID: **1910969-01**
Sample Medium: Water PWS Intake: Date/Time Collected: 09/23/19 12:20
Sample Fraction: Total Chlorophyll volume filtered (ml): Sample Depth:

Phosphorus, All Forms, Colorimetric, Automated, by EPA Method 365.1

Method: EPA 365.1

Prepared: 10/21/19 10:00

Units: mg/L

Analyzed: 10/22/19 10:14

<u>Analyte</u>	<u>Result</u>	<u>Qualifier</u>	<u>Reporting Limit</u>	<u>MDL</u>
Phosphorus as P	0.236	Q	0.0050	0.0042

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LABORATORY RESULTS

Station Code: OI-13 Received : 09/25/19 08:45 by Amber Royster
Waterbody Name: SHOAL CREEK County: CLINTON Temperature C: 3.00
Funding Code: WP06 Monitoring Unit: TMDL
Trip ID: 20190923INHS Visit Number: 001 Monitoring Program: TMDL

Notes and Definitions

- Q Maximum holding time exceeded.
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Report Authorized by:

Tom Weiss
Laboratory Manager

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